Introduction

Noise is becoming an increasingly important problem in urban life. It is one of the by-products of the modern mechanised age and much of the noise heard in cities today comes from machinery of one kind or another, principally from the various forms of transport—road, rail and air. There is, however, very rarely any *direct* gain in attempting to reduce noise; the amount of energy lost in producing quite high noise levels is small and it is also difficult to show objectively that noise has any measurable effect on the people exposed to it. At extremely high levels and for long periods of exposure it may produce deafness, but at the kind of level which exists in towns at present the impairment to health or efficiency is very difficult to detect. However, the annoyance caused by noise is apparent and the need to reduce it is obvious.

Many of the day-to-day noise problems that arise in towns need a knowledge of the noise levels so that the best advice can be given on suitable measures for the planning and construction of buildings to protect them against other people's noise. This knowledge is also necessary for the more general problem of assessing noise as an environmental factor in urban planning, and also to provide a base against which future changes can be assessed.

The survey described here was carried out in 1961-62 in the Central London area, an obvious choice. At that time London County Council were concerned with the question of ambient noise levels in London as a result of the recommendations of the committee on the planning of helicopter stations in London, and were willing to assist the Building Research Station in carrying out the survey. In their report[1] this committee stated that the noise from helicopters in level flight at 1000 ft would be no greater than traffic noises in a busy street. A survey of the kind described was necessary in order to determine what areas of London were likely to be affected by such noise levels and in particular what the noise levels were in the areas immediately around the possible sites for the helicopter station itself, since the noise from the helicopters would be greater when landing or taking-off than in level flight.

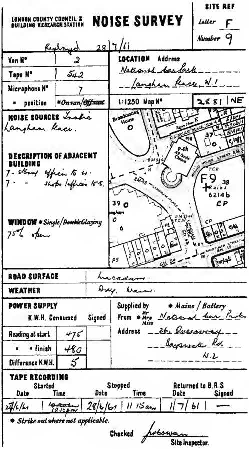
A Government Committee, under the chairmanship of Sir Alan Wilson, was set up in April 1960 to examine the nature, sources and effects of the problem of noise and to advise what further measures could be taken to mitigate it, and this also emphasised the importance of the noise problem. The Building Research Station actively assisted in providing data on noise for this committee, and in particular made a preliminary analysis of some of the results available from the London Noise Survey for inclusion in this committee's Report.[2] The Wilson Committee in the course of its investigations also commissioned a special survey into the problem of aircraft noise around London Airport. This is also described in the Report[2] and in a COI publication[3] describing the results of a social survey in that area. The London Airport survey was quite independent of the one described here and dealt with a different situation in a separate area.

The London Noise Survey was intended to investigate in a general way

a. the objective noise levels in the Central London Area in terms of the variation with respect to place, time and the kind of noise sources, and

b. the subjective effect of noise on people living in the area.

The objective survey was carried out by the Building Research Station in collaboration with and with considerable assistance from the then London County Council. The subjective survey was carried out by the Social Survey Division of the Central Office of Information (now The Government Social Survey), with Dr. A. C. McKennell responsible for its planning and analysis. The summary from this work[4] is included here as Appendix 3.



LONDON COUNTY COUNCIL & BUILDING RESEARCH STATION

NOISE SURVEY

SITE REF
Letter F
Number 9

Replayed 28/7/61

Van N°	2
Tape N°	542
Microphone N°	7
" position	*Onvan/~~Off van~~

LOCATION Address
National Car Park
Langham Place, W.1

1:1250 Map N° 2881 | NE

NOISE SOURCES Traffic Langham Place.

DESCRIPTION OF ADJACENT BUILDING
7-storey offices to W.
7- " shops/offices to S.

WINDOW **Single/~~Double~~Glazing*
75% open

ROAD SURFACE	Macadam
WEATHER	Dry. Warm.

POWER SUPPLY

	K.W.H. Consumed	Signed
Reading at start	475	
" " finish	480	
Difference K.W.H.	5	

Supplied by *Mains / Battery
From *Mr Mrs Miss National Car Parks
Address 26, Queensway
Bayswater Rd
W.2

TAPE RECORDING

Started Date	Started Time	Stopped Date	Stopped Time	Returned to B.R.S Date	Returned to B.R.S Signed
27/6/61	~~10.30am~~ 12.15pm	28/6/61	11 15am	1/7/61	—

** Strike out where not applicable.*

Checked J.W. Bowman
Site Inspector.

Figure 2
London noise survey data sheet.

Design and organisation of the objective survey

A survey such as this, intended to assess noise of all kinds present in a city, must sample noise in as representative a way as possible. Data of this kind are primarily useful to assess the amount of noise intruding into buildings and likely to affect activities inside buildings. Measurement of the noise levels inside the buildings themselves would be possible, but these levels would obviously vary with the degree of protection afforded by the building structure as well as with the outside level, and the problem of differentiating between noise produced internally and noise intruding from outside would be very difficult. The present investigation was therefore restricted to measurement of noise out of doors, since from this the resultant noise levels inside buildings could be calculated from knowledge of the sound insulation of various kinds of structure.

The exterior noise could be sampled in a number of ways. Points could be selected on the basis of the order of noise level to be expected, but it would be difficult to prove that this selection was representative. They could also be selected according to the kind of noise—road traffic, railways, industry for example—but this would not necessarily show what proportion each contributed to the problem of noise in a city such as London. It was eventually decided to sample purely on an area basis, measuring the noise at a number of equidistant points throughout the area under investigation. Provided that measurements were made at a sufficiently large number of positions so that the probability of sampling all levels and kinds of noise was high, this would appear to be the most representative basis on which to sample. In a built-up area this method of sampling could also enable an estimate to be made of the proportions of buildings and people exposed to particular kinds and levels of noise. Although such a method of sampling has not been used in previous surveys, it was thought that this method would be the least biased.

For some kinds of buildings, offices and schools for example, data on the external noise climate would only need to be obtained by day. For others, such as hospitals or dwellings, data for the night-time noise levels would also be required. Because the same external noise sources are likely to affect many different kinds of buildings, the noise level at each of the measuring points was sampled both by night and day.

On practical grounds it was thought that a representative survey of this nature would take about a year and with two sets of measuring apparatus either about 500 points could be sampled for one complete day each, or a lesser number for a proportionately longer period of time.

A pilot survey in Watford prior to the main survey sampled the noise at a number of points spaced 250 yards apart on a single line. This indicated that measuring the noise over a period of 24 hours gave a reasonably representative picture of the noise occurring during the week. (If it was likely that there would be differences between weekdays and weekends, it was intended that this should be investigated separately.) The Watford pilot survey also indicated that in the quieter residential areas the noise levels at adjacent points 250 yards apart were very similar, and the spacing finally chosen for the London Survey was therefore 500 yards (458m). This enabled an area of approximately 36 square miles of central London to be surveyed with a total of 540 measuring points.

The area surveyed, shown as the central area in Figure 1 (frontispiece), was approximately rectangular but extended slightly further in the SW direction than in the SE. This was because the LCC were more interested in the SW area as it included a possible site for a helicopter landing station. The whole area thus comprised many typical districts of different character—residential districts of various classes, industrial, including docks, shopping, commercial and city. If any significant differences in noise level existed between one kind of district and another, the survey should detect these.

On a large-scale map of the area the LCC superimposed the grid with lines spaced at 500-yard intervals, and the intersections thus pinpointed the exact position of each measuring point. The noise level at each position was sampled for one complete 24-hour day, by recording. For practical reasons it was difficult to arrange for an actual recording time much longer than 45-50 minutes at each location. The Watford pilot survey had shown that the noise level over a two-minute period was reasonably representative of the level at about the time the recording was taken. Hence the available recording time was split into 24 two-minute periods and the noise level sampled at hourly intervals during the total sampling period.

The noise level at the 540 chosen points was obtained by placing a recording van at each point for 24 hours. The LCC prepared data sheets for all the points (see Figure 2), with a small section of the large-scale map showing the exact position of the measuring point; these were intended to provide as much information relevant to the recording as possible.

Equipment used

The two recording vans each contained a microphone, signal amplifiers, tape recorder, calibrating equipment and time switches and were self-operating after they had been placed in position and set up. The microphone was a conventional moving coil, STC Type 4021 which was either mounted on top of the vehicle at a height of about 8 ft (2, 4m), or on a stand at the measuring position, and connected by cable to the vehicle. Since the microphone had to be out in all weathers it was first made waterproof by stretching a layer of thin, clear Melinex plastic sheeting across the front and around the body, completely enclosing it in a very thin 'bag'. To reduce wind noise, a cylindrical windshield 8 in. (20cm) diameter, 10 in. high covered with 'cheese cloth' enclosed the microphone. This type of material was employed because the holes between the individual strands of the silk or nylon normally used become filled with water, resulting in an appreciable difference in the sensitivity between wet and dry conditions. The overall effect on the sensitivity of the microphone due to waterproofing and wind-shielding was small and was allowed for in the calibration. The microphone output was fed into a straightforward signal amplifier of adequate dynamic range (70dB) and then to a twin-track tape recorder.

The Watford pilot survey had shown that the range of noise levels to be expected was greater than the dynamic range of any of the normal tape recorders used for noise recording. The full pass noise levels were likely to range from 30dB in a quiet location at night to over 90dB adjacent to a particularly noisy vehicle. To deal with this range of noise levels the signal from the amplifier was split to feed both channels of the tape recorder which had amplifications set to differing by 20dB. Since the cross-talk between adjacent channels was better than 30dB and the dynamic range of each channel 50dB, the quieter noises, from 30 to 80dB could be recorded on one channel and the louder, 50-100dB, on the other.

A glide tone calibration signal at a frequency varying from 50Hz to 10kHz was put at the start of each recording and a 1kHz signal at the end. Power was normally obtained from an electrical power point in an adjacent building, and this was metered and paid for by arrangement with the occupants. In this case, the signal amplifier and the tape recorder amplifiers were left running continuously and the tape transport mechanism switched by means of time clocks to operate for about a two-minute period at the same time past each hour that the initial recording at that position had been started. Since this varied in a more or less random way from position to position, all times were eventually sampled. Where no power supply was available, batteries driving a small rotary converter were used. In this case, a clockwork time clock switched on the converter half-a-minute before the recording time, to allow the amplifier to warm up and enable the whole of the recording time on the tape to be used.

The LCC made the necessary arrangements at each site, organising the placing of the vehicles and obtaining the recordings. The order of sampling the positions was reasonably irregular but, to ensure that there was no bias, alternate positions were sampled first, leaving the gaps to be filled in subsequently. The noise data obtained at some of the measuring points were to be sent to COI for correlation with the subjective data, since part of the population sample for the subjective survey was drawn from positions close enough to the measuring position for the noise data to apply directly: it was reasonable to expect that nearby dwellings would have the same noise climate as the actual measuring position. Some effort was made to measure the noise at these positions as close as possible to the time that the social survey was made by the COI.

Some of the exact positions for measurement were of course inaccessible (in the river, on top of buildings or in the middle of roads, for example). Since all the basic measurements of the survey were at street level the nearest appropriate position having, as far as could be judged, equivalent noise characteristics was chosen in such cases. It was intended that the basic information supplied by this survey should be supplemented by additional data, for example effect of height for tall blocks, effective reduction provided by various building structures against external noise and differences between weekday and weekend. Some of these factors have been investigated separately by the GLC Scientific Branch[5] and by BRS. The recorded tapes were sent to BRS at frequent intervals for analysis.

Analysis of the recorded tapes

The recorded tapes were all of approximately 45 minutes duration, with noise recorded on both channels at levels differing by 20dB and glide tone calibration signals to enable the absolute value of the noise level to be determined from a knowledge of the sensitivity of the microphone used.

The method of analysis had, if possible, to provide figures for the noise level in different situations which could be used to relate the subjective reactions from the social survey to the level of noise to which people were exposed. No objective data can directly determine disturbance or annoyance but the loudness levels of noise can be calculated for steady sounds. Several methods of loudness computation exist which require a frequency analysis of the noise into octave or one-third octave bands. The levels in the different bands are then summed in a particular way to determine loudness level.

For the analysis to keep pace with the recording at the different positions in London it was necessary to be able to deal with one or two recorded tapes per day. Calculation of loudness levels from frequency analysis was therefore impracticable since it would have taken far too much time or multiplicity of apparatus to obtain the various band pressure levels, apart from the time necessary to perform the summation into phons. Some independent work on various kinds of noise found in towns had shown that in practice a single figure of weighted sound level could be related to computed loudness level with sufficient accuracy for the purpose of the experiment. One such relationship obtained is shown in Figure 2.1 (Appendix 2), where the results are given in detail.

Table 1 'A'-weighted response curve

Frequency c/s	Relative response dB	Frequency c/s	Relative response dB
50	−30	800	−1
63	−26	1000	0
80	−22	1250	+1
100	−19	1600	+1
125	−16	2000	+1
160	−13	2500	+1
200	−11	3150	+1
250	−9	4000	+1
315	−7	5000	+1
400	−5	6300	0
500	−3	8000	−1
630	−2	10 000	−2

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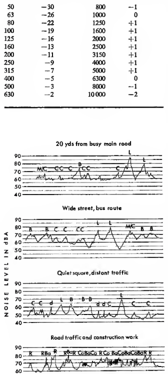

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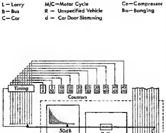


On the basis of this work, the analysis was made using an 'A' network, and the results expressed in dBA. This network is standardised nationally and internationally, and is incorporated in many pieces of acoustic equipment, and a number of other noise tests, such as those for motor vehicles, have the results expressed in dBA. The attenuation provided by this network is shown in Table 1. A further advantage of using this network was that any hum picked up on the recording at 50 or 100 Hz due to the mains was unlikely to affect the results, since these frequencies were highly attenuated. The attenuation required for the 'A' weighting was obtained from a set of filters with variable gain and this also enabled the small variations of microphone sensitivity with frequency to be taken into account.

The other factor to be considered in the analysis was the varying nature of the noise recorded. Figure 3 shows the kind of variation found in a number of typical situations over a two-minute period; thus the method of analysis had to express the proportion of time that various levels were reached or exceeded as well as the levels themselves. Van den Eijk[6] had indicated a method of measuring the proportion of time that noise levels fell between various limits and this method was adapted for use with the equipment available. The logarithmic level recorder, which provided traces such as shown in Figure 3 was used to display the variation in level during each sampling period when an 'A' network was included in the replay circuits so that the results were presented in dBA. The level recorder was modified to include an extra potentiometer and slider linked mechanically to the existing potentiometer and slider. This extra potentiometer was connected, as shown in Figure 4, to a timer and counters so that the amount of time the noise level fell between certain levels was indicated on the counter. (This statistical distribution analyser is now available commercially as an attachment to the logarithmic level recorder, but was not available at the time this work was carried out.) The level recorder used was a B & K Type 2301 with a 50 dB potentiometer and the writing speed set at 140 dB/second.

Various figures could have been obtained to specify the time variation of the noise. The equipment was able to differentiate between noise levels at 5 dB intervals and to count at the rate of 1 per second. The counters were arranged to be cumulative so that they indicated the proportion of time that the various levels at 5 dB intervals were reached or exceeded. To take account of quickly varying noises where the time in one 5 dB interval was less than one second and hence would not be recorded separately on the counter, a condenser was arranged to store charge and add this to subsequent noises in that interval to give the total number of seconds each 5dB interval was reached or exceeded in each period. It was convenient to restrict the analysis to 100 seconds during each period so that the counters gave directly the percentage of time for each 5 dB level.

The level recorder covered a range of 50 dB, as did each track of the recording, so that the appropriate channel of recording was replayed according to the range of noise encountered during each period, i.e. 30 to 80 dBA in 5 dB steps for the lower range, and 50 to 100 dBA for the higher. On the very rare

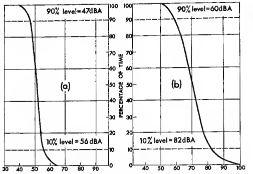


Figure 5
Distribu
with tim
period,

occasions when the range of noise level during a particular period exceeded 50 dBA, the analysis from both channels had to be examined and combined. When plotted, the results of this kind of analysis gave curves of the form shown in Figure 5. Where the noise level was comparatively steady the curve was almost vertical and straight, as in (*a*); where wide variations occurred the curve was more spread out, as in (*b*). Thus at each location, 24 such curves were obtained, one for each hour, and these were plotted on one large sheet.

In addition to the levels of noise, the recordings also gave an indication of the kind of noise causing the various levels. During the replaying the noise was reproduced from a high-quality moving coil loudspeaker and the differing noises heard could be indicated at the appropriate position on the level recorder trace. With practice many different kinds of noise could be identified—railways, aircraft, voices, roadworks or building operations, industry of various kinds and of course road traffic. The noise from different types of vehicle, heavy lorries or buses, motor cycles and private cars could sometimes be identified separately, but for none of the sources was the precise location of the source in relation to the measuring position known except in general terms from the maps supplied.

The records at each position thus consisted of:

a. the level recorder traces showing the actual variation of noise level in dBA from second to second for each of the two-minute periods at each hour, marked with the kind of noise heard;

b. the cumulative distribution graphs showing the proportion of time the noise at each hour exceeded various levels in dBA;

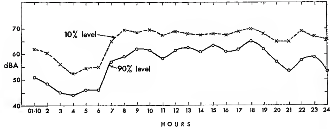
c. the original tapes, which were stored for further analysis if necessary;

d. any information on the site data sheet about the obvious noise sources, weather conditions etc. which the LCC representatives thought relevant at the time that the recordings were made;

e. further information supplied by the LCC regarding the general classification of the district in terms of its present use category.

Analysis of the data obtained

One method of presenting the results of the objective survey would be to give the full data on the levels of noise measured at each of the 540 positions for the 24 hourly periods together with the relevant details of kinds of noise heard, maps of the area, information on the particular sources existing at the time of measurement and land use classification supplied by the LCC. Such data could be used by architects, designers, town planners etc. to give a reasonable indication of the noise levels to be expected in situations broadly similar to one or more of the points actually measured. Even so, some classification would be essential for this information to be reasonably useful. (The results of sound insulation measurements between dwellings had to be presented in this way in National Building Studies Research Paper 33 since no reasonable condensation of the data could provide all the information required.) The objective data have therefore been analysed and averaged in a number of ways to enable a more comprehensive picture of the noise in London to be obtained and yet to enable architects and planners to use these data for particular situations and to enable comparisons to be



made with the results from any future survey. The basic data from the social survey, i.e. details of the completed interview schedules, have been analysed and tabulated by the COI. The complete data are not required here but the results and conclusions are summarized in Appendix 3 of this survey.

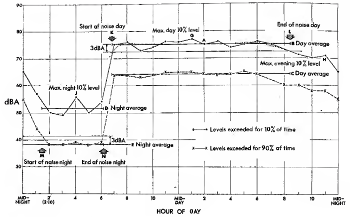
The objective data at each hour for each of the 540 measuring positions had also to be digested in some way to enable meaningful comparisons to be made. To do this, two levels, the value in dBA which was exceeded for 10% of time and the value exceeded for 90% of time, were read off from each of the 24 distribution curves for each point as indicated in Figure 5. These proportions, 10% and 90%, were to a certain extent arbitrary, i.e. there was no evidence to prefer these particular proportions instead of say, 15% and 85% or 5% and 95%. It was felt however that the 10% value gave a reasonable indication of the higher level of noise existing at any place over the sampling period and that the results expressed in this way might give some correlation with the subjective reactions from the social survey. The 10% and 90% levels were then plotted for each measuring position, giving curves of the kind illustrated in Figure 6.

Although the noise levels were sampled in 5dB steps by the statistical distribution recorder, the cumulative distribution curves obtained were normally reasonably smooth so that the 10% and 90% levels could read off more closely than at 5dB intervals. The values have actually been plotted in 1dB intervals and since the results tabulated from the data normally involve the averaging of values over periods of at least several hours, these average values are probably accurate to the nearest dB.

These curves illustrate the way in which the noise level changes over the 24-hour sampling period at each position. In almost every case the variations in the 10% and 90% curves follow each other reasonably closely during the day and evening, but during the night there are often marked differences of 10% level from one hour to another which are not necessarily reflected in the 90% level. The difference between the 10% and 90% values gives the range in which the majority, i.e. 80%, of the noise falls and indicates the variation to be expected over the sampling period at the time. The fact that the 10% levels in general when plotted produce a reasonably smooth curve showing the trend of increase or decrease in level over the whole 24-hour period also indicates that in general the two-minute sample per hour was representative. In some situations, close to some traffic routes by night or railways by day for example, the louder noises were sufficiently intermittent to be missed at some hours, but it was impracticable to change the sampling rate with the noise pattern since the recording vans were unattended.

The great majority of curves show that the noise levels were highest during the day, often being remarkably constant from early morning to evening, decreased gradually during the evening, were less—as expected—at night, and rose steeply in the early morning to the higher daytime level. The recording at most positions was generally started during the morning between 10 and 12.30 and continued until after the twenty-fourth recording was obtained; thus the noise record was actually from parts of two consecutive week-days. It was impossible to tell from the records themselves at which hour the recording started; the results are therefore independent of this time and represent the levels which were present on week-days at the time of the survey.

In order to classify these noise data and to be able to tabulate them in a suitable way so that the various noise levels, kinds of noise and relevant factors could be contrasted and compared, some averaging has to be made from the plots of 10% and 90% levels obtained at each position. To provide information for the Wilson Committee



some of the initial classification was carried out manually on part of the sample. Subsequently the full data were analysed using a Hollerith machine which enabled up to 80 different variables to be examined, each capable of taking one of ten values.

The objective data were read from the level recorder traces or the 10%/90% diagrams for each position. Taking Figure 7 as a typical diagram, the following information was listed:

1,2,3,4. Identification data for Hollerith analysis.

5,6. Latitude of position on the map grid.

7,8. Longitude of position on the map grid.

9,10. Peak noise level in dBA, i.e. the highest value shown on the level recorder trace during the 120-second sampling period, for the hours such as (A) where the actual 10% level was the same as the average for the day, i.e. peak value of average level by day.

11,12. Average 10% noise level by day in dBA, value of (B).

13,14. Average 90% noise level by day in dBA, value of (C).

15,16. Peak noise level in dBA for the hours of night where the actual 10% level was the same as the average (in some cases such as the example shown no individual 10% level was exactly the same as the average and an estimate from the values at the hours closest to the average was made).

17,18. Average 10% noise level in dBA by night, value of (D).

19,20. Average 90% noise level in dBA by night, value of (E).

21,22. Peak value in dBA from the level recorder trace, of the noise for which the 10% level by day was highest, peak value of (G), i.e. peak level of maximum noise by day.

23,24. Maximum 10% level reached by day in dBA, value of (G).

25,26. Peak value in dBA of maximum level reached during the evening, peak value of (H).

27,28. Maximum 10% level reached during the evening in dBA, i.e. value of (H).

29,30. Peak value in dBA of maximum level reached during the night, peak value of (J).

31,32. Maximum 10% level reached during the night in dBA, i.e. value of (J).

Note:
The two-figure references listed here result from most of the values being two-digit figures and therefore requiring two holes on the Hollerith machine.

Figure 7
Pattern of 10% and 90% noise levels during the 24-hour measuring period

33,34. Hour at which the noise day starts, defined as the nearest hour at which the smooth curve drawn through the 10% levels falls 3dB below the average by day, i.e. hour closest to (K). (Note the hourly ordinates of the diagram correspond to the actual time at which the two-minute noise samples were taken, ten minutes past the hour in the case of the example given, i.e. the value of (K) in the example would be 6.45 + 10 minutes = 6.55, i.e. 7 a.m. to the nearest hour.

35,36. Hour at which day ends, defined in similar way to the start, i.e. adjusted hour for (L).

37,38. Hour at which night starts, defined as the hour at which the smooth curve drawn through the 90% levels is 3dB higher than the average night-time level, i.e. adjusted hour for (M).

39,40. Hour night ends defined in a similar way to the start, i.e. adjusted hour for (N).

41,42. Hour at which maximum evening noise level occurs, i.e. adjusted hour for (H).

In each case the term peak indicates the highest level shown on the level recorder trace for the particular period chosen. The particular model of level recorder available for use was known to indicate a value which lay somewhere between the mean rectified and peak value of the waveform of the noise being measured. The modern form of level recorder can be set to indicate average, r.m.s. or peak values as desired.

From the level recorder traces, on which were marked the kind of noise heard corresponding to each few seconds of noise recorded, an estimate could be made of the predominant kind of noise, i.e., that heard most frequently and giving rise to among the highest levels at this position, and also a second choice for a subsidiary noise. The noises listed were due to: road traffic, railways, including shunting yards, adult voices, children (playing), birds, building operations and roadworks, industry, docks, weather, any other or unidentifiable noise in the principal category or aircraft noise in the subsidiary category. This information was listed as follows:

43,44. Predominant and subsidiary noise during the noise day (i.e. between the hours of start and end given in items 33 to 36).

45,46. Predominant and subsidiary noise during the evening (from day end to night start).

47,48. Predominant and subsidiary noise during the night.

49,50. Predominant and subsidiary noise during the morning (from night end to day start).

51. Particular noise causing the maximum 10% level by day, i.e. noise causing level of (G).

52. Particular noise causing maximum evening noise (H).

53. Particular noise causing maximum night time noise (J).

54. The location and kind of noise sources likely to cause levels of noise measured and identified at each position could be estimated in many cases from the maps and information supplied on the noise recording data charts. The kind of sources were: arterial roads carrying very dense traffic with many heavy vehicles; main roads with slightly less dense traffic but a good proportion of heavy vehicles; main residential roads with mainly private cars but some buses or lorries; minor roads; railways or shunting yards; building operations; industry; playgrounds; special situations; situations where no source was obvious.

55. Some indication could also be given of the relative position of the source in relation to the measuring point. This was listed as: adjacent; within 25 ft (8m) in full view; 10-20 yards (9-18m) in full view; 10-20 yards just seen (such as through an archway or passing across the end of the street in which the microphone was situated); from 10 to 20 yards with the source screened from the measuring position (by an intervening building or wall for example); from 20 to 50 yards in full view; from 20 to 50 yards just seen; from 20 to 50 yards screened; greater than 50 yards seen; greater than 50 yards screened.

56. An indication of whether the 10% or 90% noise pattern showed increases above the steady level at the beginning or end of the day which might be attributed to rush hour conditions and applicable only to positions where noise from road traffic was heard as the predominant or subsidiary noise or in positions adjacent to roads where such noise would be expected.

57. Any special characteristics of the noise pattern, i.e. where it deviated from the general pattern shown in Figure 7 and in what way.

58. Variation of the 10% noise level about the average values by day and night.

59,60. Description of the position of the measuring point in relation to the sources and characteristics of the immediate environment from LCC data.

61,62. Classification of kind of district immediately surrounding the measuring position in terms of its present use category from LCC data.

63,64. Subsidiary classification of the kind of district.

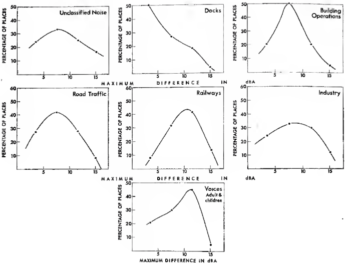


Figure 8
Variability of the observed value of the 10% noise level for different sources by day (maximum differences in 10% level observed)

Results

Noise by day

A preliminary analysis of some of the data was made before the survey was completed so that some information could be given to the Wilson Committee for inclusion in their report if required. This analysis was made by band and confirmed that at a great many positions the predominant noise by day was due to road traffic, as would be expected. These positions were sub-divided into groups having the same day-time average 10% noise level, the highest group coming in the range 82–78 dBA, the next 77–73 dBA and so on. It was seen that the points in the higher noise ranges were almost invariably at the kerbside of extremely busy arterial or main roads carrying heavy traffic and that in the lower ranges the points were well clear of, or screened from, traffic. This information, together with the corresponding 90% day-time levels and the 10% and 90% night-time levels is a measure of the noise climate and is given in Table 2 (p.12).

From a more detailed analysis of the noise data it is obvious that measurements at points spaced 500 yards apart do not enable noise contours to be drawn on a map. A very much closer spacing of the points would have been necessary for this, resulting in a smaller area or a number of much smaller areas being surveyed in greater detail. The results would then have only been applicable to the particular areas chosen and would not be representative of other positions except where these were virtually identical with regard to the noise sources, distances, and sizes of adjacent buildings etc.

The preliminary analysis had shown that noise from road traffic predominated in many places and from other experiments it is known that motor vehicles produce most noise when using maximum engine power. In towns this occurs generally when they are accelerating rapidly in low gear, and is observed particularly with heavier commercial vehicles since these need to use most of their power more frequently under town driving conditions. Private cars and other vehicles can, if accelerating hard, produce high noise levels but are not so often driven in this way. In any given street, therefore, the noise level could vary from point to point depending on the way in which the traffic is behaving, for instance moving at more or less constant speed in the range 0 to 30 mile/h (0 to 48 km/h), braking, accelerating and so on. No observations of the density, speed or make-up of the traffic were made as part of the London Noise Survey since the noise measuring vehicles were left unattended for virtually all the recording time, and only general information as to the kind of road and traffic using it was obtained. Further, the noise levels obtained in analysis cannot be identified with a particular vehicle or vehicles nor with vehicles at particular distances (such as are specified for vehicle noise tests).

Similar considerations apply to other kinds of noise—roadworks or building site noise in particular. In places where such noises were observed no detailed information was given of the kind of plant being used at the time that the noise vehicles were set up, nor of the distances involved, since these could in fact have varied from time to time during the course of the day's measurements. The analysis has therefore been carried out in terms of the various noise levels identified in the list relating to Figure 7 together with the other environmental factors; grouping and averaging similar examples, contrasting differences and showing the range of noise level to be expected in particular situations. As further examples, however, more detailed information is given of the data obtained in 54 of the actual survey positions, i.e. one position in ten, and these examples have been chosen to be reasonably representative of the total. These are given in Appendix 1 where each figure includes a sketch map showing the location of the microphone in relation to the adjacent roads, railway and other likely noise sources, and gives the 10% and 90% noise levels at each hour, the kind of noise heard at each hour and the relevant information about the immediate locality.

Average values of the 10% noise level

The average 10% noise levels for those points where traffic noise predominates by day are given in Table 3 in terms of the location of the measuring position with respect to the road likely to be the principal noise source.

The table shows that the highest noise levels (82 dBA) are obtained at positions on or in full view of arterial roads and that the average daytime 10% noise level falls off as the amount of traffic likely to be using the road decreases and also with the distance from it or with the degree of screening present. The average 10% noise levels by day likely to be obtained in a given situation in relation to the traffic routes, can be estimated from the mean values given and the range of values for similar positions measured in the survey.

Figure 8 shows the kind of variability observed in the 10% noise levels in different situations. This is the maximum difference in 10% noise level at different hours of the day, the deviation from the average 10% level by day being approximately half this difference. Where road traffic is the predominant noise heard, the majority of places have maximum differences of between 5 and 10 dBA, i.e. the actual noise level at any hour is unlikely to differ from the average for the day by more than 5 dBA. For railways these values are somewhat higher, between 7 and 13 dBA maximum differences in most places, or up to about 7 dBA for the deviation from the average.

Where voices predominate the maximum of the curve occurs at 11 dBA, since voices close to the measuring microphone caused appreciably higher noise levels at some times of day but not at others. The remaining curves are based on comparatively few examples but give an indication of the likely spread in 10% noise levels. The maximum of the curve for dock noises presumably occurs at a very low value, showing that where this kind of noise is the predominant one heard it normally has a comparatively steady value throughout the day. Table 4 sets out the same information in a way which shows the average daytime noise level in steps of 3 dBA and the kind of situation in which such noise levels are to be expected.

In the interim analysis for the Wilson Committee, it was convenient to arrange the results for the positions at which road traffic noise predominated in groups for which the average 10% noise level by day differed in steps of 5 dBA. In the present analysis the difference between the steps has been reduced to 3 dBA and the number of noise level groups correspondingly increased to 11. Figure 9 shows the distribution obtained when the results at all the measuring points are considered, not just those with traffic noise predominant, and the numbers in each group are plotted against daytime 10% noise level. The average of this noise level for the whole sample of 540 points is 66,3 dBA with a standard deviation of 6,5 dBA, the median value is 65 dBA with half the values falling between 62 and 71 dBA, and the modal value is 64 dBA.

Figure 10 shows the way in which other average values vary with respect to the 10% daytime average value. It is seen that the difference between the 10% and 90% values is smallest, about 6 dBA, in the quietest situations and double this in the noisiest situations. The average minimum level is about 3 dBA below the 90% level everywhere, and the peak pressures associated with the average 10% levels are about 6 dBA above the 10% level.

Start and length of day

The noise-day is defined in this analysis as the period between the times when the smooth curve drawn through the 10% noise levels plotted at each hour of day falls to 3 dBA below the steady level obtained over most of the day. A smooth curve is necessary because the individual variations

Table 2 Noise level range at locations where traffic noise predominates

Group	Location	Noise climate dBA*		Percentage of the total numbers of points measured falling in each group†
		Day	Night	
A	Arterial roads with many heavy vehicles and buses (kerbside)	80–68	68–50	4
B	(i) Major roads with heavy traffic and buses (ii) Side roads within 15—20 yd of A or B group roads	75–63	61–48	12
C	(i) Main residential roads (ii) Side roads within 20–50 yd of heavy traffic routes (iii) Courtyards of blocks of flats screened from direct view of heavy traffic	70–60	54–44	17
D	Residential roads with local traffic only	65–57	52–44	19
E	(i) Minor roads (ii) Gardens of houses with traffic routes more than 100 yd distant	60–52	48–43	21
F	Parks, courtyards, gardens in residential areas well away from traffic routes	55–50	46–41	9
G	Places of few local noises and only very distant traffic noise	50–47	43–40	1

Table 3 Average 10% noise levels from traffic in different locations

Measuring position relative to source	Arterial roads			Main roads		
	Average level dBA	Range dBA	Number of positions	Average level dBA	Range dBA	Number of positions
Adjacent	77	70–82	26	72	61–79	35
Within 25ft (8m) full view	74	67–82	16	71	64–76	10
Within 10–20 yd (9–18m) full view	72	64–82	7	67	—	1
10–20 yards just seen	71,5	64–79	11	66	61–73	7
10–20 yards screened	67	64–70	3	63	52–73	6
20–50 yards full view	67	64–73	5	73	—	3
20–50 yards seen	69	61–76	10	68	58–76	8
20–50 yards screened	63	58–70	5	66	61–70	4
Above 50 yards seen	65	61–70	5	65,5	64–67	2
Above 50 yards screened	61	58–64	5	61	58–64	3

Table 3—continued

Measuring position relative to source	Main residential roads			Minor roads		
	Average level dBA	Range dBA	Number of positions	Average level dBA	Range dBA	Numbers of position
Adjacent	67	58–76	57	62	55–70	30
Within 25ft (8m) full view	67,5	61–73	6	67	61–73	4
Within 10–20 yd (9–18m) full view	64	—	2	—	—	—
10–20 yards just seen	67	61–73	12	64	—	1
10–20 yards screened	57	52–64	3	60	52–64	5
20–50 yards full view	—	64 and 76	2	—	61 and 64	2
20–50 yards seen	64	—	1	64	58–70	3
20–50 yards screened	64	—	2	—	—	—
Above 50 yards seen	—	—	—	—	—	—
Above 50 yards screened	58	—	1	—	—	—

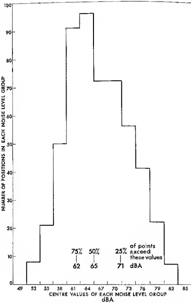
Table 4 Traffic situations causing different noise levels

Typical noise level (10% level by day) dBA	Location of measuring position (Number of examples in parentheses)
82	Only on or very close to arterial roads (6 examples)
79	On or close to arterial roads (12). On few main roads (3)
76	On or seeing arterial roads up to 20 yds (15). Close to main roads (11). On some main residential roads (3)
73 70 67	In many situations, distant or screened from the louder sources, closer to the quieter sources
64	Screened from arterial roads. On some main roads (5) (less noisy parts). On and affected by main residential roads (23), on minor roads (8)
61	A few quieter situations relative to main roads. On and close to some main residential roads (9). On more minor roads (16)
58 55 52	Few situations (5) in relatively quiet locations

from hour to hour are sometimes as much as 3 dBA. In most cases the smooth curve can be drawn without ambiguity, but at some positions particular peaks or dips in the 10% level at the beginning or end of the day cause some uncertainty.

Table 5 shows the number of positions at each level of noise which have noise-days of various lengths. It is seen that short noise-days, 8 hours or less, occur in 3% of places where the average daytime noise level generally has values between 60 and 70 dBA, but Figure 9 shows that over half the total sample have values in this range and it is more likely that the short noise-days will also be found here. Table 5 also shows that the day exceeds 16 hours in 7% of places. The remaining 90% of places have day lengths between 9 and 16 hours with a central tendency of 11 to 14 hours, with the greatest numbers again occurring in the more common noise level groups 60 to 70 dBA.

The straightforward average of the length of day in each noise level group shows a slight tendency for a longer day at the higher levels but average values of 12 hours or more are obtained at almost all levels. It is obvious, however, that the actual length of the noise-day at a particular position is likely to have any value between 8 and more than 16 hours, irrespective of noise level. The corresponding figures for the hour at which the day starts are shown in Table 6. Only 3½% of places are outside the range 5-9 a.m. Most of the positions have a day starting within these limits, with a tendency towards the middle of the range for both noise and hour. The average hour is 7 a.m. with a slightly earlier start at places with the higher noise levels.



Variation in 10% noise level about the average

The results at many of the positions measured show noise patterns, of the kind illustrated in Figure 7, which are reasonably regular and allow various average figures to be obtained. Variations of the actual level from hour to hour throughout the day are to be expected, however, since in very few places is noise produced at a constant level, or the source fixed in relation to the measuring position. Table 7 shows the number of positions in each noise level group for which the range of variation falls within the limits shown. The average variations range from 3½ to 8 dBA by day, i.e. the 10% level at a particular hour is normally within 2 dBA of the average values in the louder situations and within 4 dBA in the quieter places. At 4% of places (denoted as 'Unclassified' in Table 7) the variation either exceeded 13 dBA by day or the pattern was such that a meaningful average value could not be obtained. The greatest variation occurs in the middle groups where the sample is largest.

Night-time variations are generally greater than by day, in fact in many cases where the noise-night is comparatively short an average value of the 10% level over 3 or 4 hours, when the variation may exceed 10 dBA, carries little meaning. In many cases the high values of 10% level at certain hours [illegible] road, rail, and occasionally aircraft. By day a sufficient number of sources are heard during each two-minute sampling period to give consistent levels from one hour to the next. By night the sources are fewer and may happen to be present during the sampling period at some hours and not at others, thus causing markedly different levels to be obtained. Nevertheless, the average variation by night is from 5 to 10 dBA, i.e. the actual levels at a particular hour are likely to differ by 2 to 5 dBA from the mean. The range of variation to be expected from different kinds of noise source, road traffic, railways industry etc. have been shown in Figure 8.

Further characteristics of the 24-hour noise patterns

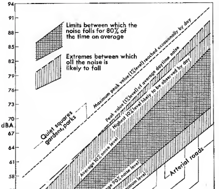
The 24-hour noise patterns were examined to see whether other characteristics, in addition to the variations about the average level given in Table 7, could usefully be related to the 10% level. These are given in Table 8, in which the noise is rated as steady whenever an average value can reasonably be assigned to the level over a period and

Figure 9
Average daytime values of noise level exceeded for 10% of time.

Table 5 Length of noise day

Average 10% level by day dBA	Number of positions Length of day—hours <8	8	9	10	11	12	13	14	15	16	>16	Average duration hours
82	—	1	—	—	1	1	1	2	—	1	—	12,5
79	—	—	3	2	1	1	3	3	1	4	3	13,5
76	—	—	3	2	2	10	7	6	6	1	4	13,5
73	—	1	2	6	3	10	9	9	6	5	5	13,5
70	1	1	3	4	13	8	15	9	6	5	6	13
67	2	1	5	7	8	16	8	9	7	3	5	12,5
64	1	5	5	7	11	22	18	11	10	1	4	12,5
61	1	2	7	8	11	15	17	11	6	4	9	12,5
58	1	1	6	2	7	9	10	5	5	3	1	12
55	—	—	—	3	2	3	4	2	2	2	—	11
52	—	—	—	—	—	2	1	2	—	2	1	12
Percentage of total	3		6	7,5	11	18,5	17	13	9	6	7	

Figure 10
Range of noise levels observed by day.



variable when this cannot be done. Under the heading 'Characteristics of noise pattern', the first three groups account for about two-thirds of all the positions, and have similar noise patterns to the typical pattern given in Figure 7 with the following exceptions:

a. Positions in the second group are subject to irregular noises during the night, giving levels which vary significantly from hour to hour.

b. In the third group a higher level, due perhaps to an aircraft, a heavy vehicle or perhaps voices close by, happens once or twice during the day.

The distribution of 10% noise level across the table is very much the same in the first group as for the whole sample of 540 points, i.e. it consists mainly of points where the average daytime 10% noise level is 60 to 70 dBA. The second group has its greatest numbers about 5 dBA higher, i.e. the noisier situations by day tend also to be more disturbed at some hours of the night. In the third group, the greatest numbers occur at a lower noise level than the average, i.e. in the quieter situations an occasional louder peak is more likely to be observed at some time or other during the course of the day. The only other large group is that in which the daytime 10% level is variable, and this may either be because of a true variation in the noise from one part of the day to another, or to its irregular occurrence at intervals greater than two minutes, causing the noise to be observed at some hours and not at others.

Traffic noise at rush hours

Since road traffic causes the predominant noise at many places, variations in traffic density might be expected to cause corresponding variations in noise level. No measurements of traffic density were made, but it is obvious that in many places traffic is denser at rush hours, morning and evening than at other times. The noise records were therefore examined to see whether any of the measured levels showed appreciable increases at these times.

Most increases that are noted do not relate to specific hours, such as might be defined as rush hours for other purposes. The results of this analysis are shown in Table 9. At two-thirds of the measuring points there is no indication of an increase in noise level at rush hours (but for some of these positions traffic is not the predominant noise, therefore no increase would be expected). At 4% of places the variation throughout the day is too large to make an estimate of the average level, hence an estimate of any increase in the average level at rush hours is also impossible; as in Tables 7 and 8, these are shown as 'Unclassified'. For the remaining 30% of places, Table 9 gives the number of positions where the increase in noise level is up to 3 dBA, and from 3 to 6 dBA, at the beginning or the end, or both at the beginning and the end, of the noise-day.

In the majority of cases the indicated increase does not exceed 3 dBA and tends to occur more frequently in the morning, or both morning and evening rather than only at the end of the day. In some one-way streets it might be expected that a rush-hour indication would only occur at one end of the day, but it is unlikely that the method of selecting and measuring points, by placing the 500 yard grid on a map, would favour roads most used during the morning.

Streets most likely to show a marked increase in noise level at rush hours are those used as alternative routes when the main roads become overcrowded. These residential streets are usually in the lower noise level groups, but the distribution among these groups for the 30% of points showing rush-hour noise patterns is essentially the same as the distribution of the whole sample. Thus when an increase in noise level at rush hours does occur, it is general rather than restricted to particular noise level groups. No definite conclusions can be drawn from this particular analysis.

Kind of noise heard by day

During analysis of the noise levels at each position the recordings were replayed through a good quality loudspeaker so that the source of noise could often be identified by ear. The noise heard most frequently at any point and giving rise to the higher levels has been classified as the principal noise and where appropriate a subsidiary noise has also been listed.

These classifications are given in Table 10 in terms of the range of level observed in each category, the average level and the number of examples observed. The classifications for principal and subsidiary noise are the same, i.e. road traffic, railways, voices etc., except that aircraft noise replaces unspecified noise in the last category of subsidiary noise since this only occurs infrequently and is never the principal noise observed. The same information is retabulated in Table 11 in order of descending average 10% noise level by day.

Table 6 Hour at which day starts

Average 10% level by day dBA	Number of positions Hour day starts (a.m.) 03	04	05	06	07	08	09	10	11	After 11	Average hour
82	—	—	1	2	3	1	—	—	—	—	6.30
79	1	—	4	7	6	3	—	—	—	—	6
76	1	1	2	8	19	8	2	—	—	—	7
73	—	—	3	15	22	14	2	—	—	—	7
70	—	1	3	17	28	20	2	—	—	—	7
67	—	—	4	11	40	12	2	1	1	—	7
64	1	—	4	15	39	27	5	2	1	1	7
61	—	1	3	15	41	25	4	1	1	—	7
58	—	—	2	9	24	12	2	1	—	—	7
55	—	—	—	7	9	2	1	—	1	—	7
52	—	2	—	—	3	2	—	1	—	—	7
Percentage of total		1.5	5	20	44	23.5	4		2		

Table 7 Variation of 10% noise level during the day

Average 10% level by day dBA	Average day-time variation dBA	Number of positions											Average night-time variation –dBA
		Range of variation–dBA										Unclassified	
		by day	<6			6–9			10–13				
		by night	<3	3–6	6–12	3–5	6–10	12–18	5–8	9–14	15–25		
82	3,5			2	3	—	—	1	—	—	—	1	6
79	5,5		1	1	6	1	5	2	1	1	—	4	7
76	5,5		1	4	13	1	6	10	—	2	2	2	8,5
73	6		—	4	14	3	14	12	1	6	—	2	8,5
70	7,5		1	8	11	4	11	7	7	15	5	3	9
67	8		1	3	8	5	10	18	9	10	1	7	10
64	8		2	8	7	6	28	6	25	11	1	2	6,5
61	8		2	11	3	10	19	2	27	11	3	3	6,5
58	7,5		2	5	3	8	12	—	9	11	—	—	6,5
55	6,5		1	7	—	3	4	—	4	1	—	1	5
52	7,5			2	—	—	4	1	1	—	—	—	8
Percentage of total			2	10	13	8	21	11	16	12	2	4	
			25			40			30				

Table 8 Characteristics of the 10% 90% noise pattern

Characteristics of noise pattern	Number of positions											Percentage of total
	Average 10% noise level by day—dBA											
	82	79	76	73	70	67	64	61	58	55	52	
Steady by day and night	3	4	11	17	19	20	26	20	10	13	4	27
Steady by day, variable at night	2	7	16	22	19	16	9	5	2	—	—	18
1 or 2 peaks by day	—	1	1	5	10	11	19	35	20	4	—	20
Day difficult to define	1	3	6	6	4	5	9	4	4	1	2	8
Night difficult to define	—	—	1	—	—	—	1	1	—	—	—	0,5
Variable by day and night	1	1	3	3	6	9	7	7	3	1	—	8
Steady day with intervals (industry)	—	1	—	2	3	1	2	—	1	—	—	2
Variable day steady night	—	2	2	—	9	6	18	18	8	1	2	12
Unclassified	—	3	1	1	2	4	5	1	2	1	—	4

Figure 11 shows the distribution of the various observed noise levels, 90% and 10% average values, maximum 10% values and peak (or 1% values) for the three principal kinds of noise heard, road traffic, railways and voices. The curves for road traffic are in general broader, showing that a wider range of values is observed. For railways and voices the peaks are sharper and a more definite figure can be given to the most probable value for each kind of level.

Distribution of noise level among various kinds of district

The LCC classified the different parts of London in terms of the current use category. The immediate areas round each of the measuring points could therefore be classified in this way and the results examined to see whether particular kinds of district were essentially noisier than others.

The use categories specified by the LCC were as follows:

1. *Residential*
   - *a*. Private houses detached or semi-detached
   - *b*. Houses semi-detached or terrace—low rating
   - *c*. Old dwellings 4 or more storeys high
   - *d*. New dwellings 4 or more storeys high
   - *e*. Old residential with some industry or commerce
   - *f*. Noise-sensitive buildings: schools, hospitals, churches etc.

2. *Industry*
   - *a*. Industry only
   - *b*. Mixed use, primarily industrial

3. *Shops*
   - *a*. Street markets
   - *b*. Local shops
   - *c*. Main shopping centres
   - *d*. West End shops

4. *Railways*
   - *a*. Unspecified
   - *b*. Elevated (embankment or bridge)
   - *c*. Level
   - *d*. Depressed (cuttings)
   - *e*. Sidings or shunting yards

5. *Offices*
   - *a*. General including other uses
   - *b*. West End
   - *c*. City

6. *Open spaces*
   - *a*. Laid out, parks, gardens etc.
   - *b*. Uncultivated, waste ground etc.
   - *c*. Riverside (excluding docks)

7. *Commercial*
   - *a*. Warehouses
   - *b*. Warehouses and docks
   - *c*. Mixed including offices and industry
   - *d*. Showrooms

8. *Building operations or roadworks in progress.*

Each measuring position was classified (by the LCC) into one of the foregoing groups for its primary use and again if relevant for its secondary use. In the primary classification over half of the points come in the residential category. When these are stratified into noise groups the distribution with noise level is essentially the same as for the whole sample, i.e. a few at the extremes but the majority towards the mean of the noise range. About 7% of places are classified as industrial, with examples in each noise level range, and this is close to the percentage given in Table 10 for positions where industrial noise is the primary one heard. However, in only half of the places classified as being industrial locations is industrial noise predominant, and correspondingly about half of the locations where industrial noise is predominant are not in areas classified as industrial.

Those points in shopping districts, about 6% of the total, fall mainly in areas of street markets or West End shops. The daytime 10% noise levels are in general slightly higher than the average for all positions but this is presumably because shops are more frequently associated with busy traffic.

In category 4, railways, there are twice as many places indirectly affected, i.e. in the subsidiary classification, as there are directly affected. Those directly affected are either immediately adjacent to an extremely busy main railway line or are in goods or marshalling yards in which fairly extensive and continuous operations are taking place. In the other situations, such as adjacent to many lines running into and out of London, the amount of traffic on the railway is comparatively light, in comparison for instance with the amount of traffic on the adjacent roads. The average daytime 10% noise level in situations where railway noise is predominant is rather higher than in corresponding situations affected by road traffic, and the levels produced as engines pass or particularly noisy operations such as steam blowing or whistling occur may be as high as 85-90 dBA. The few examples where railways are in cuttings or are depressed but still produce the predominant noise have average 10% levels ranging from 61 to 76 dBA with a mean value 1 or 2 dBA lower than the corresponding positions on the level. Those positions having railways as the subsidiary use classification are distributed among the 10% noise level groups in a similar way and have mean values similar to the general distribution for all points.

The points in the other use classifications—offices, open spaces and commercial—have no particularly unexpected noise characteristics. In the open space group, over 50% of the places have 10% average daytime noise levels of 60 dBA or less, i.e. they are in places comparatively remote from traffic or other noise sources. Category 8, roadworks or building operations, appears only as a subsidiary classification and is not strictly a present use category for planning purposes, but the presence of this potential noise source was noted as part of the information given by the LCC representatives who visited the site. No information is given of the particular building operations taking place or the distances involved; examples occur in almost every noise group and the distribution is similar to the average for all positions.

The loudest noises during the day

The 24-hour noise patterns are most useful in giving the average values of noise level to be expected by day and night. The highest value which the 10% level reaches may also be significant since this may determine the insulation required in a particular building structure to achieve a certain standard of quietness inside. The maximum value may also be important in relating the noise levels to which people are exposed to their subjective reactions. Table 12 shows the proportion of places having different maximum 10% noise levels. It is seen that half of the places measured have maximum values of 73 dBA or higher and two-thirds have values higher than 70 dBA. Values as high as 79 dBA occur almost as frequently as in the groups 10 dBA lower, and maximum values of 82 dBA are not uncommon.

Table 9 Change of noise level at rush hours

Average 10% level by day dBA	Number of positions							
	No rush hour indication	Amounts of rush hour increases—dBA						Unclassified
		Morning		Evening		Both		
		0–3	3–6	0–3	3–6	0–3	3–6	
82	5	1	—	—	—	—	—	1
79	17	1	—	—	—	—	—	4
76	31	6	1	—	—	1	—	2
73	43	8	—	1	—	3	—	1
70	51	5	1	3	2	8	1	1
67	49	5	2	5	—	4	3	4
64	59	11	3	5	1	11	3	3
61	51	13	10	1	1	10	3	2
58	28	7	3	3	—	4	2	3
55	17	2	—	—	—	—	1	1
52	6	1	—	1	—	—	—	—
Percentage of total	66	11	3,5	3,5	0,5	7,5	2,5	4

Figure 11
Distribution of average, maximum and peak noise level values observed by day from three sources.

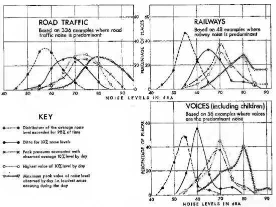


Table 10 Kind of noise heard by day

Note: Figures in parentheses are average values

Subsidiary noise heard	Principal noise heard by day–levels and number of positions in each category																			
	Road traffic		Railways		Voices		Children		Birds		Building Operations		Industry		Docks		Weather		Unspecified	
	No.	Range and average level—dBA	No.	Range and average level—dBA	No.	Range and average level—dBA	No.	Range and average level—dBA	No.	Range and average level—dBA	No.	Range and average level—dBA	No.	Range and average level—dBA	No.	Range and average level—dBA	No.	Range and average level—dBA	No.	Range and average level—dBA
Road traffic	70	55–82 (72.5)	22	55–79 (65.5)	15	55–76 (63)	15	55–73 (62)	3	55–64	13	61–79 (68)	15	58–79 (67)	10	55–67 (61)	1	55	4	52–64 (58)
Railways	22	58–76 (67)	—	—	2	58–61	2	58 and 67	—	—	1	61	1	67	—	—	—	—	—	—
Voices	139	55–82 (68)	4	58–70	—	—	8	58–64 (61)	1	58	1	67	5	55–73 (64)	4	58–70	1	55	3	58–79
Children	41	52–76 (65)	7	61–79 (67)	1	52	—	—	3	55–58	2	61	2	61 and 64	—	—	—	—	1	61
Birds	17	52–73 (62)	—	—	2	55 and 61	6	52–61 (57)	—	—	—	—	—	—	1	61	—	—	1	52
Building operations	13	58–82 (70)	6	61–82 (70)	1	58	2	64 and 67	—	—	1	76	1	61	1	70	—	—	—	—
Industry	6	61–73 (66)	1	64	—	—	—	—	—	—	—	—	4	64–79 (70)	—	—	—	—	—	—
Docks	5	61–70 (66)	—	—	—	—	—	—	—	—	1	67	—	—	6	55–64 (61)	—	—	—	—
Weather	3	58–64 (61)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	55
Aircraft	20	58–79 (64)	8	61–76 (67)	1	55	1	55	—	—	—	—	5	64–73 (67)	—	—	1	58	2	64 and 67
Totals	336		48		22		34		7		19		33		22		3		12	
Percentage of each kind	62,5		9		4		6,5		1,5		3,5		6		4		0,5		2	

Table 11 Noise heard and average level measured by day

Noise level dBA		Noise heard		Number of positions
Average	Range	Principal	Subsidiary	
72,5	55–82	Road	Road	70
70	61–82	Railways	Building operations	6
70	58–82	Road	Building operations	13
70	64–79	Industry	Industry	4
68	55–82	Road	Voices	139
68	61–79	Building operations	Road	13
67	61–79	Railways	Children	7
67	58–79	Industry	Road	15
67	61–76	Railways	Aircraft	8
67	58–76	Road	Railways	22
67	64–73	Industry	Aircraft	5
66	61–73	Road	Industry	6
66	61–70	Road	Docks	5
65,5	55–79	Railways	Road	22
65	52–76	Road	Children	41
64	58–79	Road	Aircraft	20
64	55–73	Industry	Voices	5
63	55–76	Voices	Road	15
63	58–70	Railway	Voices	4
62	55–73	Children	Road	15
62	58–70	Docks	Voices	4
62	52–73	Road	Birds	17
61	55–67	Docks	Road	10
61	58–64	Children	Voices	8
61	58–64	Road	Weather	3
61	55–64	Docks	Docks	6
58	52–64	Unspecified	Road	4
57	52–61	Children	Birds	6

Table 12 Maximum 10% noise levels and their likely locations

Maximum noise level dBA	Percentage of places	Likely locations
91	0,5	Within 25 ft (8m) of some railways
88	0,5	On or very close to arterial or main roads (6 examples). By some railways
85	2	
82	5,5	Within sight of arterial roads. On other roads
79	14	Within sight of some railways. On many roads
76	15	Below this value examples occur in almost all possible locations
73	14	
70	19	
67	15	
64	6	
<64	8,5	

Table 13 shows how the points are distributed with respect to the kind of noise heard and the likely source of the noise. Over half of the positions sampled have road traffic as the noise heard and roads as the obvious source of the noise. At approximately one-fifth of the places, the noise causing this maximum level during the day could not be positively identified when listening to the recordings being replayed, and is therefore in the unknown category. The points in this category are widely distributed among the likely sources. A further 5% of places have railway noise causing the maximum daytime 10% levels and adjacent railways as the obvious source. The remaining 25% of places are widely spread among the other categories of noise heard and likely source.

In Table 14 are shown the ranges of maximum 10% noise level and the average values for various locations of measuring position in relation to the most probable noise source. In most cases these maximum noise levels are likely to be due to one or more particularly noisy vehicles which are most frequently found on the arterial or main roads, but may of course be heard in many locations. The effect of varying distances from the source and different degrees of screening is shown best by the data relating to arterial roads. In other situations presumably the same degree of attenuation for individual noises occurs, but other noises produced nearer to the measuring position are louder than the attenuated noises from a distance.

The most likely locations for various maximum noise level values are included in Table 12, with the percentage of places likely to have these levels. Table 15 shows the relation between the most typical noise (or predominant noise) heard over the greater part of the day and the particular noise observed to give rise to the highest value of 10% level, i.e. what is normally the loudest noise at each position.

Table 13 Source of loudest noise heard by day
(Based on maximum 10% level observed by day)

Most obvious noise source	Number of positions									
	Kind of noise heard									
	Road traffic	Rail-ways	Voices	Child-ren	Birds	Building oper-ations	Industry	Docks	Weather	Unknown
Arterial road	74 (14%)	1	1	3	—	3	—	—	1	15
Main road	70 (13%)	2	—	5	—	5	1	—	—	14
Main residential road	84 (16%)	1	2	8	—	4	1	—	—	16
Minor road	47 (9%)	4	3	7	1	5	4	—	1	12
Railway	8	21 (4%)	—	1	—	1	—	—	—	8
Building operations	1	—	—	—	—	1	—	—	—	1
Industry	13	—	—	2	—	—	9	1	—	8
Playground	—	—	1	2	1	—	1	—	—	3
Unclassified	10	6	1	3	1	2	—	11	1	18
None obvious	2	—	—	—	—	—	—	—	—	2
Totals	309	35	8	31	3	21	16	12	3	97
Percentage of each kind	58	6	1,5	6	0,5	4	3	2	0,5	18

Road traffic is the most widespread source, and it is therefore not unexpected to find that it causes the loudest noise in many situations where other kinds of noise normally predominate since noisy vehicles may have access to almost any place on occasions. Since, also, road traffic predominates at by far the largest number of positions it is reasonable that, at a few of these, other sources of noise can occasionally be louder. The expected correlation, diagonally across the table, shows the number of positions where the normal noise and the loudest noise are from the same source. Finally, aircraft, as potentially loud noise sources which occur comparatively infrequently, never appear as the most typical noise at any location but can give rise to the highest levels in almost any situation.

Table 14 Noise levels from road and rail traffic in different locations (Based on maximum observed value of 10% noise level by day)

Measuring position relative to source	Arterial roads			Main roads			Main residential roads		
	Average level dBA	Range dBA	Number of positions	Average level dBA	Range dBA	Number of positions	Average level dBA	Range dBA	Number of positions
At kerbside	80	73–88	26	75,5	67–85	35	73	63–82	73
Within 25ft (8m) full view	77	70–85	16	76	67–79	12	71	64–82	7
Within 10–20 yd (9-18m) full view	75,5	67–82	7	70	70	1	72	63–76	4
10–20 yd just seen	75	70–82	11	72	64–88	10	72	64–82	14
10–20 yd screened	73	70–79	4	69	63–76	9	70	63–76	11
20–50 yd full view	72	67–76	5	78	76–82	5	—	67 79	2
20–50 yd seen	74	67–79	11	71	64–76	11	70	—	1
20–50 yd screened	67	64–76	7	70	63–79	7	68	63–73	3
Above 50 yd seen	68	64–73	5	67	64 and 70	2	—	—	—
Above 50 yd screened	66	63–73	6	67	63–70	5	67	64 and 70	2

Table 14—continued

Measuring position relative to source	Minor roads			Railways		
	Average level dBA	Range dBA	Number of positions	Average level dBA	Range dBA	Number of positions
At kerbside	69,5	63–82	54	78	67–91	13
Within 25ft (8m) full view	71,5	63–79	9	80	70–91	3
Within 10–20 yds (9-18m) full view	79	79	1	—	70 and 73	2
10–20 yd just seen	69	63–70	4	75	70–82	4
10–20 yd screened	67	63–73	8	—	76 and 82	2
20–50 yd full view	68	64–73	3	79	79	1
20–50 yd seen	74	70–76	3	74	67–79	5
20–50 yd screened	—	63 and 76	2	73	67–79	4
Above 50 yd seen	—	—	—	73	67–79	4
Above 50 yd screened	—	—	—	—	63	1

Table 15 Comparison of loudest and average noise by day

Loudest noise heard	Number of positions									
	Most typical noise heard by day									
	Road traffic	Railways	Adult voices	Children	Birds	Building operations	Industry	Docks	Weather	Unknown
Road traffic	252	11	7	13	1	5	12	5	—	3
Railways	6	27	—	1	—	—	1	—	—	—
Adult voices	2	—	4	—	1	—	1	—	—	—
Children	16	—	—	12	3	—	1	—	—	—
Birds	—	—	—	1	2	—	—	—	—	—
Building operations	8	—	—	—	—	11	—	2	—	—
Industry	1	—	—	—	—	—	14	1	—	—
Docks	2	—	—	—	—	—	—	10	—	—
Weather	—	—	—	1	—	—	—	—	1	1
Aircraft	49	10	11	6	—	3	4	4	2	8
Totals	336	48	22	34	7	19	33	22	3	12
Percentage of each kind	63	9	4	6,5	1	3,5	6,5	4	0,5	2

Noise by night

The detailed results given for noise by day have been presented in terms of the 10% levels. In this section a similar analysis is made, but based on the 90% levels at night. The 90% level, i.e. the level of noise in dBA which is exceeded for 90% of the time, has been taken to define the period of night, since in many places this is a reasonably constant figure over a period of several hours for which an average value can be quoted. Louder noises often occur for short periods at some hours and not at others, making the 10% level a very variable quantity during the night so that an average value for this would not be appropriate.

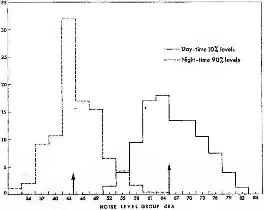
Distribution with noise level

Figure 12 shows the percentage of positions which have average 90% noise levels by night between 31 and 64 dBA in steps of 3 dBA. For comparison the corresponding distribution of 10% levels by day is also given, from which it is seen that the most probable difference between 10% day and 90% night noise levels is only 20 dBA, although any difference within the range 30–80 dBA is possible. Table 16 gives the difference between the daytime and night-time 10% values (not the 90% night-time values as in Figure 12). It shows that differences, day minus night, of up to 25 dBA can be obtained in many places. The most likely difference in almost all situations is about 12–15 dBA and only in the small number of quiet places is the average difference less than this.

Relationship between 90% levels and higher values

Figure 13 shows that, in as far as it is possible to specify a figure for the 10% noise level at night, the value exceeds the 90% level by between 6 and 9 dBA. The upper curve, however, shows that at particular hours the actual 10% level is likely to have a much higher value than average, the excess being as much as 15 dBA in the quieter locations, falling to about 6 dBA at the higher end of the scale. The peak or 1% value of the average noise level, is in excess of the 10% level by about 8 dBA in the quieter locations but this reduces to 5 or 6 dBA, similar to the daytime difference, at the higher noise levels.

Figure 12
Comparative distribution of daytime and night-time average noise levels



In Figure 14 the distribution of average, maximum and peak noise levels by night is shown (and may be compared with the corresponding results by day, Figure 11). Only two sources, road traffic and railways, provide a sufficiently large sample to enable distributions to be plotted.

Start and length of night

The start and finish, and hence duration, of the noise night are defined in terms of the points on the noise/time pattern for which the 90% values are 3 dBA above the general night-time average as shown in Figure 7. Examination of the data shows that the times for which the night starts and ends are substantially independent of the average noise level.

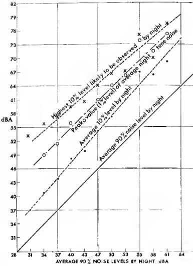
Figure 15 shows the percentage of places having the start and end of the noise-night at the times shown. The greatest number of places have the start at midnight and the end between 5 and 6 a.m., giving an average duration of 5½ hours. Table 17 shows that at those places having the highest and lowest average noise levels, the duration is not likely to be markedly different from the average but towards the middle of the range, where the greatest number of positions occur, there are larger deviations from the average value. Compared with the average length of day, the noise-night is comparatively short and ends almost everywhere by or before 7 a.m.

Kind of noise heard by night

Table 18 details the number of positions, irrespective of the actual level of noise, at which various kinds of noise are heard, in terms of the principal and the subsidiary noise. It is seen that road traffic is still predominant and is the principal or subsidiary noise at 80% of the places measured. The principal noise of the next largest group is due to railways and here the proportion is rather greater than during the day, presumably because the noise due to other sources is reduced or absent at night rather than because the noise of railways is any louder. Aircraft, voices and birds are the other sources which contribute significantly to the overall pattern of noise heard by night and these are heard as the subsidiary noise in approximately equal numbers of positions.

The distribution with noise level among the largest group, i.e. where road traffic is the principal noise source, is essentially similar to the overall distribution for the whole sample at night given in Figure 12. This similarity is not unexpected since over two-thirds of the total sample are in this group.

There is little correlation between the 90% average values of noise level at night and the position of the measuring point in relation to likely noise sources such as main roads. This, again, is not unexpected since the noises contributing to the 90% night-time level probably originate over a wide area and are attenuated in various ways when travelling over longer distances. The higher values of peak and 10% daytime levels are almost invariably due to local sources and the measured level can be markedly affected by the degree of screening between the source and measuring point.



The sources of the loudest noises heard at night are shown in Table 19 and this may be compared with the corresponding Table 15 for daytime noises. The same kind of pattern is present in both tables but at night a higher proportion of places are found in the four possible combinations of road traffic with railways.

Type of district

Analysis of the night-time noise levels in terms of the LCC classification of the district immediately surrounding each measuring point (residential, industrial, commercial, etc.) shows no significant deviations from the general noise pattern given in Figure 14. A few cases where the 90% average noise levels are in excess of 55 dBA occur in almost every kind of district so, as with the previous analysis, the measured 90% levels are not so much affected by the immediate environment but the noise is collected from over a wide area.

Variability of the 10% noise level by night

The 10% noise level varies more by night than it does by day. Table 20 shows the number of positions at each average 90% level having the total variations from 2 to 20 dBA shown. The variation

Figure 13
Range of noise level observed by night

Table 16 Difference between day and night 10% noise levels

Average 10% level by day dBA	Number of positions: Day-night differences (3dBA increments) 1	4	7	10	13	16	19	22	>22	Average difference dBA
82	—	1	1	—	4	—	—	—	1	12,5
79	—	2	4	2	2	2	2	2	5	15,5
76	2	1	6	7	7	8	2	2	6	14
73	—	4	8	6	7	9	11	6	5	15
70	—	1	8	13	11	15	10	5	8	15
67	—	4	3	10	17	20	8	7	2	14,5
64	—	5	9	16	23	24	10	7	1	11,5
61	—	3	10	25	20	21	11	1	—	12,5
58	—	1	12	15	14	7	—	1	—	11
55	2	1	5	10	2	1	—	—	—	8,5
52	—	3	3	1	1	—	—	—	—	8
Percentage of total	5,5		13	20	20	20	10	6	5	

Figure 14
Distribution of average, maximum and peak noise levels observed by night from two sources.

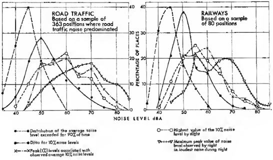


Figure 15
Hour at which night starts and ends.

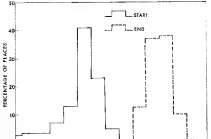


Table 17 Length of noise night

Average 90% level by night dBA	Number of positions Length of night-hours 0	1	2	3	4	5	6	7	8	9	10	11	>11	Average duration hours
>62	—	—	—	—	—	1	—	—	—	—	—	—	—	5
61	—	—	—	—	1	1	—	—	—	—	—	—	—	4
58	1	—	—	1	—	3	1	1	—	—	—	—	2	6
55	—	—	—	4	4	6	3	5	—	—	—	—	—	5,5
52	—	—	—	1	4	12	3	3	3	1	3	1	4	7
49	1	—	1	2	17	25	11	8	6	6	3	1	2	6
46	—	—	1	8	12	24	22	13	2	7	1	—	—	5,5
43	—	—	—	9	25	47	42	23	11	2	8	2	1	6
40	—	—	—	4	9	19	13	7	4	—	2	—	—	5,5
37	—	—	—	3	8	19	14	1	1	2	—	—	1	5,5
34	1	—	—	2	1	3	4	—	—	—	—	—	—	4,5
<33	4	—	—	—	—	—	—	—	—	1	—	—	—	
Percentage of total	1,5		0,5	6,5	15	30	21	11,5	5	3,5	3,5	1	2	

Table 18 Kind of noise heard by night

Subsidiary noise heard	Principal noise heard by night and number of positions in each category Road Traffic	Rail-ways	Voices	Child-ren	Birds	Building operat-tions	Industry	Docks	Weather	Un-classified
Road traffic	159	38	1	—	7	—	2	6	9	6
Railways	48	15	—	—	2	—	3	1	—	6
Voices	46	1	—	—	2	—	—	1	—	1
Children	—	—	1	—	—	—	—	—	—	—
Birds	47	5	—	—	—	—	—	—	—	2
Building operations	1	—	—	—	—	—	—	—	—	—
Industry	1	1	—	—	—	—	5	—	—	—
Docks	7	1	—	—	1	—	—	6	1	1
Weather	18	1	—	—	2	—	—	1	1	3
Aircraft	36	16	1	—	—	—	—	2	1	—
Totals	363	78	3	—	14	—	11	17	12	19
Percentage of each kind	70	15	1	—	2,5	—	2	3	2,5	3,5

Note: Because night-time range of levels is generally large and average values are not particularly relevant, range and average values corresponding to those in the day-time table (Table 10) are not quoted.

about the average 10% level, if such a figure is meaningful for the comparatively short night period, when the values at individual hours may vary quite widely, is half the total variation. It is seen that the variation is smaller at the few noisiest positions but has an average value of 8 dBA for the majority of places. Although there is a central tendency towards this average value, there are significant numbers towards the extremes of the range.

General characteristics of the noise pattern

Examination of the shape of the 10%/90% noise patterns throughout the 24-hour sampling period and analysis in terms of the 90% night-time noise level shows no significant difference from the corresponding analysis made in terms of the daytime 10% levels, and these results have already been given in Table 8.

Table 19 Comparison of loudest and average noise by night

Loudest noise	Number of positions								
	Most typical noise by night								
	Road traffic	Railways	Voices	Birds	Building operations	Industry	Docks	Weather	Unknown
Road traffic	302	20	—	5	—	3	2	6	9
Railways	15	50	1	—	—	2	1	—	2
Voices	10	—	1	—	—	—	—	1	—
Birds	11	3	—	9	—	—	—	—	1
Building operations	1	—	—	—	—	—	—	—	—
Industry	—	1	—	—	—	4	—	—	—
Docks	3	1	—	—	—	—	12	1	1
Weather	4	1	—	—	—	—	—	2	2
Aircraft	17	4	1	—	—	3	2	2	20
Totals	363	80	3	14	—	12	17	12	35
Percentage of total	67,5	15,0	0,5	3,0	—	2,0	3,0	2,0	6,5

Table 20 Variation in night-time noise level about the average value

Average 90% level dBA	Number of positions							Average variation dBA
	Total variation of 10% noise level dBA							
	2	4	6	8	12	16	20	
>62	1							2
61	1	1						3
58	1	5		1	2			6
55		5		10	1	5	2	10
52	2	9	1	15	3	3		7
49	1	19	12	29	12	7	1	8
46	2	17	10	36	10	9	2	8
43	1	28	28	58	26	22	3	8,5
40	1	5	12	20	5	8	2	8,5
37		3	19	8	9	4	1	8
34	1	2	2	4			1	7
<33			2				1	10

Noise at other times

The noise day and night, having been defined as the periods over which the appropriate noise values are substantially constant, occupy betweeen them the greater part of the 24-hour period during which noise measurements were made at each position. The remainder of the time is split between a very short 'morning' and in general a rather longer evening. The morning is short because the noise level increases very rapidly at the end of the night and often achieves the average daytime level within an hour or so, whereas the decline in noise level at the end of the day is normally more gradual. The noise patterns given in the typical examples in Appendix 1 illustrate these trends.

The 10% noise levels during the evening show some fluctuations about the smooth curve joining day and night-time average values, and it was thought possible that the maximum evening noise might have been important in people's subjective assessments of their own noise climate. The Social Survey[4], summarized in Appendix 3, showed that neither this value, nor any other of the figures which defined the noise climate, were related to the subjective data in any way which could be considered significant.

Analysis of the physical data shows that the highest value of the 10% level during the evening and the hour at which it occurs have no particular characteristics worth tabulating.

Subjective assessments of noise

The full-scale social survey, in which over 1300 people, who were living in noise climates which it was thought could be reasonably defined from the objective results were interviewed, was organised entirely by the COI. It was intended to relate noise to other factors, i.e. to see what part noise played in assessing people's environment, and to see what other factors might be relevant. The summary from this survey[4] is given in Appendix 3.

In addition to the full-scale subjective survey the opportunity was taken for a smaller survey to be carried out by members of the BRS staff in an attempt to correlate some judgement of loudness of typical street noises with the measured levels in dBA. The people who made these judgements were part of the larger sample who had been selected in a random fashion by the COI. The experiments were carried out after the interview for the main survey had taken place so that each persons' awareness of noise should not have been aroused prematurely.

The object of this experiment was to get a judgement of the loudness of typical street noise of a measured level; this might prove useful in assessing the results of the large subjective survey, where the figures for the noise climate on one particular day which were available might not represent the typical noise climate to which the person being interviewed was normally exposed. Such judgements could also be related to the results obtained from other experiments in which particular groups of individuals had been asked to make judgements regarding aircraft noise and motor vehicles under controlled conditions.[7–11]

The experiment entailed asking each person interviewed to come to a suitable place, normally just outside their own house, for a short period, and to judge the loudness of two noises in terms of the four-point scale consisting of: extremely loud; very loud; fairly loud; not loud at all.

The first judgement was of an artificial noise made by the falling-ball acoustic calibrator, at a standard distance of one metre, producing a sound level of 72 dBA. The second judgement was of the street noise obtaining at the time, and this was recorded during the period of the interview and subsequently analysed to give the mean and peak values of sound level in dBA. The kind of noises which occurred during the period were also noted.

The results of these loudness judgements are shown in Figure 16. For the judgement of street noise, an inner shaded area has been drawn to include about 70% of the results obtained. At the left, the figure shows the proportion of people making judgements, on the same four-point scale, of the standard artificial noise at a level of 72 dBA. For comparison, the results obtained with groups of listeners under controlled conditions making judgements of noisiness (as distinct from loudness) on motor vehicles and aircraft are shown on the right. It is obvious that considerable differences occur between peoples' judgement of the loudness or noisiness of different kinds of noise source. Whereas any noise having a level of not more than 60 dBA will almost certainly be rated as quiet, judgement of an extremely loud (or noisy) situation, will occur at widely differing sound levels depending on the kind of source. Even experiments under roughly com-

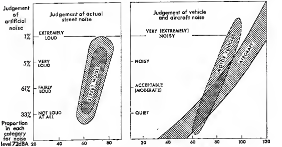


Figure 16
Comparative judgements of different noises.

parable conditions with selected teams of listeners but judging different kinds of sources, such as motor vehicles and aircraft, give curves of differing slope. The results of the experiment in London were obtained with the individuals in their own environment and judging noise which was quite familiar to them, so they may presumably be applicable to any other similar situation for which such judgements may be needed.

Analysis by the GLC

Further analysis was made by the staff of the Scientific Branch of the GLC and is given in the report 'Research into noise levels in London'.[12] Some of the tables and figures from that document are reproduced here as Tables 21–25 and Figures 17 and 18.

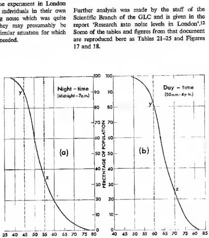


Figure 17
Percentage of population subjected to different values of noise level
(a) by night, and (b) by day. Points at which criterion recommended by Wilson Committee (50dBA inside living rooms by day or 35dBA inside bedrooms by night) are exceeded with: (y) windows partly open, and (z) single window closed.

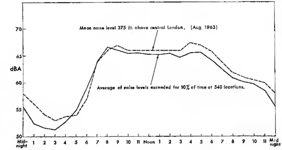


Figure 18
Comparison of average of all 540 measured points with value measured at 375 ft in central London (top of GPO Tower).

Table 21 Noise levels (dBA) classified according to type of road and period of day

Road class and microphone position (see below)	Rush hour (7 a.m.–10 a.m. 4 p.m.–7 p.m.)		Day (10 a.m.–4 p.m.)		Evening (7 p.m.–midnight)		Night (midnight–7 a.m.)		Number of measuring sites	
	Median noise level	Noise climate	Median noise level	Noise climate	Median noise level	Noise climate	Median noise level	Noise climate		
A	71	76,5–66	70,5	76 –65,5	65	72 –61	57,5	67,5–51,5	41	
AX	64	68,5–59,5	63,5	68,5–59,5	59	65 –54,5	52	59 –48	39	
B	64,5	72,5–60	64	71,5–58,5	58,5	67 –53,5	49	57 –46	23	
BX	61,5	68 –57,5	61,5	67,5–58	55	62 –51	46,5	53,5–43,5	11	
C	62	68 –57,5	63	69 –58,5	55	62 –51	47	53,5–44	15	
CX	62	67,5–58,5	62	68 –58	55,5	60 –52	47	51 –44,5	11	
D	57,5	63,5–54,5	57	62,5–53,5	52,5	57,5–49	45,5	50,5–43	118	
DX	57,5	63 –54,5	58	62 –55	51	57 –49	47	51 –44,5	61	
D/A	62,5	68 –58,5	62,5	67,5–58,5	58,5	64,5–54,5	51,5	58 –47,5	54	
D/AX	60	66 –56,5	60	65 –57	55	60,5–51,5	49	54 –46,5	13	
D/B	60	66 –56,5	60	65,5–56	55	60,5–51	49	52,5–46	23	
D/C	59,5	65,5–55,5	57,5	64 –54	53,5	59 –50,5	48	52 –45,5	17	
E	54	58,5–52	55	58 –53	50,5	54 –48,5	47,5	50 –45,5	18	
E/A	59,5	63 –57,5	60	63 –54,5	55	59 –53	51	55 –49	36	
E/B+E/C	57,5	61,5–55	57	61 –54	51,5	54,5–50	47,5	50,5–45,5	13	
E/D	56,5	61 –53,5	56,5	60 –53,5	51,5	55 –49	47,5	50,5–45	13	
AXX+BXX	55,5	60 –53	56	60,5–53	51,5	55,5–48,5	47	51 –45	12	
CXX+DXX	55,5	60 –52,5	56,5	60,5–54	50,5	54,5–47,5	46	49,5–43	22	540
A combined	67,5	72,5–63	67	72 –62,5	62	68,5–58	55	63 –50	80	
B ,,	63,5	71 –59	63	70 –58,5	57,5	65,5–52,5	48	55,5–45	34	
C ,,	62	68 –58	62,5	68,5–58	55	61 –51,5	47	52,5–44	26	
D ,,	58,5	64,5–55	58,5	64 –55	53,5	59 –50	47,5	52,5–45	286	
E ,,	57,5	61,5–55	58	61 –54	53	56,5–51	49	52,5–47	80	
XX ,,	55,5	60 –52,5	56	60,5–53,5	51	54,5–48	46,5	50 –43,5	34	540
All points on road	61,5	67,5–57,5	61	66,5–57	56	62 –52	49	55 –46	291	
All points off road	58,5	63,5–55,5	59	63 –55,5	53,3	58 –50,5	48,5	53 –46	249	540

TYPE OF ROAD

- A. *MoT Class 1* Predominantly through traffic. Red on O.S. Map
- B. *MoT Class 2* Through traffic, local traffic and bus routes. Brown on O.S. Map
- C. *MoT Class 3 and 4* Predominantly local traffic with some bus routes. Yellow on O.S. Map
- D. Purely local traffic, no buses. Uncoloured on O.S. Map
- E. Open space
- X. Off road, but not shielded from it
- XX. Off road, shielded from noise in road by buildings, walls, etc.
- D/A. In D road, but affected by noise from A road
- E/A. On open ground, but affected by noise from A road
- D/B. In D road, but affected by noise from B road
- E/B. On open ground, but affected by noise from B road
- D/C. In D road, but affected by noise from C road
- E/C. On open ground, but affected by noise from C road
- E/D. On open ground, but affected by noise from O road

Table 22 Noise levels (dBA) classified according to type of area and period of day

*Most of the 540 measuring sites have been classified as being in more than one type of area

Type of area (See below)	Rush hour (7 a.m.–10 a.m. 4 p.m.–7 p.m.)		Day (10 a.m.–4 p.m.)		Evening (7 p.m.–midnight)		Night (midnight–7 a.m.)		*Total number of measuring sites in each area
	Median noise level	Noise climate	Median noise level	Noise climate	Median noise level	Noise climate	Median noise level	Noise climate	
1.1	59,5	65 –55,5	58,5	65 –54,5	55	61,5–51	48	53 –45,5	26
1.2	58,5	64 –55	58	64 –54	54	60 –50	47	51,5–44	129
1.3	61	66 –57	60,5	66,5–57	56	61,5–52,5	49,5	54,4–46,5	79
1.4	61,5	65,5–56	59,5	65 –55,5	54	60,5–50,5	46,5	51 –45	44
1.5	61	67 –57	61,5	66 –57	55	61 –51	48,5	54 –45,5	93
1.6	58,5	64 –55	59	64 –56,5	54.5	59 –50	47,5	52 –44,5	67
2.1	61,5	67 –59	63	68 –60	53	57 –50	49,5	52,5–47	18
2.2	60,5	64,5–56,5	60,5	65,5–58	54,5	60 –51	49,5	54 –46	27
3.1	60,5	68 –56	60,5	66,5–57,5	54	61 –49,5	46	51 –43	5
3.2	64	70 –59,5	63	69 –59,5	58,5	65 –54	51,5	55,5–48	29
3.3	67	72,5–63	66	72 –62	63,5	69 –57,5	56,5	65 –51	7
3.4	67	72 –63,5	68	72 –64,5	64,5	69 –60,5	55,5	63,5–50,5	12
4.1	61,5	69 –57,5	62,5	66 –57	55	62,5–51	49,5	54 –46,5	25
4.2	61,5	69 –56,5	63	70 –57,5	56,5	63,5–52	49,5	56,5–46	9
4.3	63	69 –59	61	67,5–56,5	58,5	65,5–53	52	56,5–48	9
4.4	62,5	68,5–59	62,5	68 –58,5	59,5	65,5–55,5	54	60 –50,5	17
5.1	63,5	69 –60,5	64	69 –61	58	63,5–54,5	52	58,5–48,5	16
5.2	65,5	71,5–62	66,5	69 –63	61	67,5–57,5	53	57,5–49	20
5.3	62,5	67 –59	63	67 –60,5	55	61,5–51	51,5	58,5–48	11
6.1	59,5	64,5–56	59	64 –55,5	55	60 –52	49	53 –46	85
6.2	61,5	66,5–58	61,5	66,5–58	55,5	60,5–52	50	55,5–47	13
6.3	62	65 –59,5	62	64,5–59,5	56,5	60 –54	52,5	57 –50	17
7.1	59,5	65 –55,5	59,5	65,5–56	53	59 –49,5	47,5	52,5–44,5	5
7.2	59,5	63 –57,5	61,5	63 –58,5	52	55,5–50	50	51,5–48	29
7.3	62,5	68 –58,5	62,5	68 –59,5	54	60,5–51	49	55,5–44,5	20
7.4	65	69,5–61	66,5	71 –62,5	58,5	63,5–54,5	50,5	58,5–57	5

TYPE OF AREA (Classified according to present use)

Residential districts
1.1 Houses semi or detached—mostly private
1.2 Houses semi-detached and terrace—low rating
1.3 Houses, flats and maisonettes—4 or more storeys—old
1.4 Houses, flats and maisonettes—4 or more storeys—new
1.5 Old residential with some industry and/or commerce
1.6 Noise sensitive buildings, e.g., schools, colleges, hospitals, churches

Industry
2.1 Industry only
2.2 Mixed uses, primarily industrial

Shops
3.1 Street markets
3.2 Local shops
3.3 Main shopping centres
3.4 West End shops

Railway (diesel, electric and steam)
4.1 On embankments or elevated
4.2 On level
4.3 In cuttings
4.4 Goods yards and carriage sidings

Offices
5.1 Offices and other uses
5.2 West End
5.3 City

Open spaces
6.1 Laid out—public and private open space
6.2 Uncultivated, allotments, vacant land, etc
6.3 R. Thames excluding docks and other uses

Commerce
7.1 Warehouses
7.2 Warehouses and docks
7.3 Mixed—warehouses, offices and/or industry
7.4 Commerce with showrooms

Table 23 Noise levels (dBA) classified according to principal type of area and period of day

Type of area	Rush hour		Day		Evening		Night	
	7 a.m – 10 a m	4 p.m – 7 p.m.	10 a m.–4 p.m.		7 p.m.–Midnight		Midnight–7 a m	
	Median	Noise climate	Median	Noise climate	Median	Noise climate	Median	Noise climate
Residential districts	60	65–56	60	65–55,5	55	60,5–50,5	48	52–45
Industry	61	65,5–57,5	62	66,5–59	54	58,5–50,5	49	53,5–46
Shops	65	70,5–60,5	64	70–61	60	66–55,5	52	58–48,5
Railway	62	69–58	62	67,5–57,5	57	64–53	51	56,5–48
Offices	64	69,5–60,5	65	68,5–61,5	59	64,5–55	52	58–48,5
Open spaces	60	65–57	60	64,5–56,5	55	60–52,5	50	54–46,5
Commerce	61	65,5–58	62	65,5–59	53	58–50,5	49	53,5–47

Table 24 Summary of noise levels classified according to type of road and period of day

Road classification	10% Daytime (7 a.m.– 7 p m.)	10% Evening (7 p.m.– 12 midnight)	10% Night (12 midnight– 7 a.m.)	Number of points
MOT Class 1	72	68,5	63	80
MOT Class 2	70,5	65,5	55,5	34
MOT Class 3	68	61	52,5	26
Unclassified	64	59	52,5	286
Open space	61,5	56,5	52,5	80
Screened from traffic (by buildings)	60	54,5	50	34
All points on road	67	62	55	291
All points off road	63	58	53	249

Table 25 Summary of noise levels classified according to type of area and period of day

Type of area	10% Daytime (7 a.m.– 7 p.m.)	10% Evening (7 p.m.– 12 midnight)	10% Night (12 midnight– 7 a.m.)	Number of points
Residential districts	65	60,5	52,5	438
Industry	66	58,5	53,5	45
Shopping	70	66	58	53
Railway	68	64,9	56,5	60
Offices	69	64,5	58	47
Open spaces	64,5	60	54	115
Commerce	65,5	58	53,5	59

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Frontispiece map taken from the Greater London Ordnance Survey sheet.

Appendix 1

Typical results

Analysis of the data from all 540 points shows the average values likely to be found in different places. To give an indication of the actual levels and kinds of noise experienced in particular places the detailed data at one position in ten are given in the following figures.

Each figure shows:

a. A small sketch-map showing the exact position of the measuring point in relation to the roads, surrounding buildings and noise sources. The area covered by the sketch is approximately 120 yd × 130 yd (110 x 119m).

b. The noise levels, hour by hour throughout the 24-hour recording period, exceeded for 10% (upper curve) and 90% (lower curve) of time. The highest peak noise level observed during the period is also shown. In most cases the noise pattern is such that an average value for the daytime 10 and 90% levels can be indicated by a horizontal bar, and the hour at which the day starts and ends (defined as the points at which the 10% noise level drops to 3 dBA below the average) are also shown by vertical arrows. The corresponding average values and hours for the night are generally indicated but, as can be seen from many of the records, tha variations from hour to hour are such that an average has not much meaning. The principal noises heard at each hour are indicated along the top or bottom of the diagram.

c. A summary of the information available about the measuring point is also given with the diagrams.

The predominant noises in the 54 individual results given in Figures 1.1 to 1.54 are:

Road traffic (or general residential noise in the quieter areas) in the first 31 examples (A1 to T18), Figures 1.1 to 1.31.

Railways in the next 6 examples (A11 to R8), Figures 1.32 to 1.37.

Aircraft at a number of hours in Posn. T10, Figure 1.38.

Building operations in the next 5 examples (B14—T14), Figures 1.39 to 1.43.

Industrial noise in the next 6 examples (A20—L18), Figures 1.44 to 1.49.

Dock noise in two examples (H21 and R4), Figures 1.50 and 1.51.

River noise in two examples (A18 and H13), Figures 1.52 and 1.53.

A covered market, example H18, Figure 1.54.

Key to Figures 1.1—1.54

Position:

The letter and number combination is the reference identity of each measuring position on the 1:1250 map which was used to pin-point each position at intersections of the 500 yd grid used for the survey.

Sketch maps

✱ Measuring point (microphone, in most cases, not more than 8ft from the ground)

▨ Buildings (inset numbers, where shown, are house numbers)

☐ Open sites

▤ Canals, dock and river

The scale appearing on Figure 1.1 is common to all except Figure 1.27 which carries a smaller scale.
NOTE: 1 yd=0,915m.

Noise diagrams (graphs)

The data are plotted at the nearest hour (i.e. a measurement made at 11.05 would be shown at 11 o'clock, at 11.35 it would be shown at 12 o'clock).

— —·—·— Noise level (dBA) exceeded for 10% of the time.

-x--x--x- Noise level (dBA) exceeded for 90% of the time.

⊙ Highest peak level during recording period.

— Average values (where appropriate).

↑ Limit of noise day or night is indicated by vertical arrows pointing up or down.

The noises heard at each hour are indicated along the top or bottom of each group by the following identifying letters:

A	Aircraft.
B	Building operations or roadworks.
C	Children playing.
D	Dogs barking.
E	Stationary engine.
F	Factory noise.
G	General residential noise.
H	Hammering or banging.
I	Industrial noise.
M	Motor cycle if predominant among traffic noise.
O	Ornithological (bird) noise.
P	'Pop' music.
R	Road traffic noise.
S	Speech.
T	Train noise.
W	Weather, wind or rain.

Figure 1.1

POSITION. A 1 LOCATION: KILBURN HIGH ROAD, N.W.6 DATE RECORDED: 26.9.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: MICROPHONE AT THE EDGE OF ARTERIAL ROAD CARRYING BUSES AND HEAVY TRAFFIC

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC EVERY HOUR SOME
BUILDING OPERATIONS OR ROADWORKS.
RAILWAY ½ MILE AWAY

TYPE OF DISTRICT:

MAIN SHOPPING CENTRE
OLD RESIDENTIAL

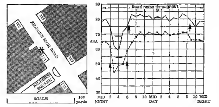


Figure 1.2

POSITION: A 24 LOCATION: LAURISTON/WETHERELL/GROVE ROADS, E.9 DATE RECORDED: 10.10.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: AT JUNCTION OF 4 ROADS CARRYING BUSES AND HEAVY TRAFFIC. VICTORIA PARK ADJACENT

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC, AIRCRAFT AND
GENERAL BACKGROUND NOISE AT NIGHT

TYPE OF DISTRICT:

RESIDENTIAL: HOUSES AND HOTEL
ADJACENT TO PARK

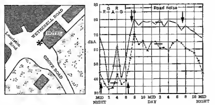


Figure 1.3

POSITION: Q 27 LOCATION: DEPTFORD HIGH STREET/NEW CROSS ROAD, S.E.14, DATE RECORDED: 5.11.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON JUNCTION OF SEVERAL BUSY MAIN ROADS

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC NOISE THROUGHOUT

TYPE OF DISTRICT:

MAIN SHOPPING CENTRE WITH
DWELLINGS ABOVE.

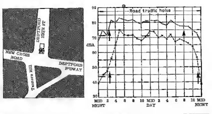


Figure 1.4

POSITION: A 4 LOCATION: FINCHLEY ROAD, N.W.3. DATE RECORDED: 22.8.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: 30 FT. FROM THE EDGE AND IN FULL VIEW OF BUSY MAIN ROAD.

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC NOISE THROUGHOUT

TYPE OF DISTRICT:

RESIDENTIAL DETACHED HOUSES;

LARGE GARDENS

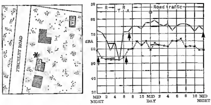


Figure 1.5

POSITION: G 13 LOCATION: ALDWYCH, W.C.2. DATE RECORDED: 2.8.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: AT KERBSIDE OF MAIN ROAD (ONE-WAY) WITH HEAVY TRAFFIC

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC AT ALL HOURS.

COMPRESSOR ALSO AT 10 AND 11 A.M.

TYPE OF DISTRICT:

TALL OFFICE BLOCKS/COMMERCIAL

BUILDINGS

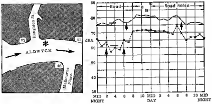


Figure 1.6

POSITION: G 26 LOCATION: COMMERCIAL ROAD, E.14. DATE RECORDED: 18.10.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: AT EDGE OF BUSY MAIN ROAD

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC NOISE THROUGHOUT

TYPE OF DISTRICT:

OLDER RESIDENTIAL WITH

SOME INDUSTRY

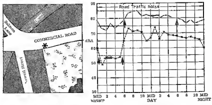


Figure 1.7

POSITION: B 9 LOCATION: MORNINGTON TERRACE, N.W.1 DATE RECORDED: 15.5.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: AT EDGE OF RESIDENTIAL ROAD USED AS THROUGH ROUTE; ADJACENT TO MAIN LINE RAILWAY

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC AND TRAINS

TYPE OF DISTRICT:

4 STOREY TERRACE HOUSES

FACING RAILWAY

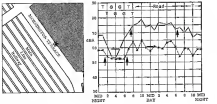


Figure 1.8

POSITION: C 23 LOCATION: KINGS CROSS ROAD, W.C.2. DATE RECORDED: 18.1.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: AT ROAD EDGE. JUNCTION OF SEVERAL ROADS

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC THROUGHOUT.

SOME CHILDREN'S VOICES

TYPE OF DISTRICT:

LOCAL SHOPS, DWELLINGS,

OFFICES, SOME INDUSTRY.

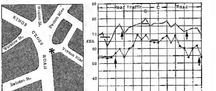


Figure 1.9

POSITION: G 7 LOCATION: GRANVILLE PLACE/PORTMAN STREET, W.1. DATE RECORDED: 16.4.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON CORNER OF MINOR ROAD IN FULL VIEW OF TRAFFIC OF MAJOR ROAD WITH BUSES

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC AT ALL HOURS

TYPE OF DISTRICT:

WEST-END SHOPS, FLATS,

OFFICES. 5 STOREY

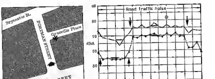


Figure 1.10

POSITION: Q 13 LOCATION: CLAPHAM ROAD, S.W.9. DATE RECORDED: 6.3.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: AT SIDE OF MAIN ROAD CARRYING HEAVY TRAFFIC

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC NOISE THROUGHOUT THE DAY AND NIGHT

TYPE OF DISTRICT:

OLD RESIDENTIAL; SOME INDUSTRY/COMMERCE.

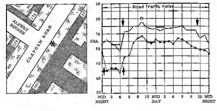


Figure 1.11

POSITION: A 15 LOCATION: GASKIN/UPPER STREETS, N.1. DATE RECORDED: 26.9.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: AT SIDE OF MINOR ROAD. MAIN ROAD TRAFFIC SEEN AT 30 YARDS

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC AT EVERY HOUR. SOME SPEECH DURING THE LATE EVENING.

TYPE OF DISTRICT:

OFFICES/SHOPS/INDUSTRY. 4 STOREY.

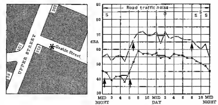


Figure 1.12

POSITION: B 29 LOCATION: PEARSON STREET/KINGSLAND ROAD, E.2. DATE RECORDED: 9.10.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON MINOR ROAD. MAIN ROAD TRAFFIC SEEN AT 50 YARDS

PRINCIPAL NOISES HEARD:

MAINLY ROAD TRAFFIC. SOME CHILDREN'S VOICES AND TRAINS

TYPE OF DISTRICT:

OLDER RESIDENTIAL. SOME INDUSTRY AND COMMERCE

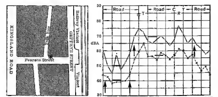


Figure 1.13

POSITION: S 27 LOCATION: ADDINGTON ROAD, E.3. DATE RECORDED: 11.10.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON MINOR ROAD. MAIN ROAD TRAFFIC SEEN AT 50 YARDS. SOME ROAD WORKS

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC NOISE AT ALMOST EVERY HOUR. SOME TRAIN AND COMPRESSOR NOISE.

TYPE OF DISTRICT.

OLDER RESIDENTIAL. SOME INDUSTRY/COMMERCE

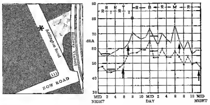


Figure 1.14

POSITION: F 7 LOCATION: BLANDFORD STREET/BAKER STREET, W.1. DATE RECORDED: 11.4.61

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: MILK DEPOT OPPOSITE

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC NOISE THROUGHOUT

TYPE OF DISTRICT:

SHOPS AND OFFICES IN 5 AND 7 STOREY BLOCKS.

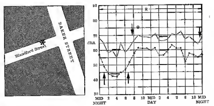


Figure 1.15

POSITION: S 2 LOCATION: FRISTON STREET/WANDSWORTH BRIDGE ROAD, S.W.6 DATE RECORDED: 21.9.61

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON MINOR ROAD WITHIN 20 YARDS OF MAIN ROAD

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC NOISE THROUGHOUT

TYPE OF DISTRICT:

2/3 STOREY RESIDENTIAL HOUSES/FLATS.

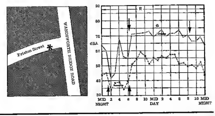


Figure 1.16

POSITION: F 9 LOCATION: LANGHAM PLACE, W.1. DATE RECORDED: 27.6.61

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON OPEN GROUND IN FULL VIEW OF MAIN ROAD WITH BUSES

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC AT ALL HOURS.

SPEECH ALSO AT HOURS SHOWN.

TYPE OF DISTRICT:

7 STOREY OFFICES/SHOPS TO SOUTH.

PUBLIC BUILDINGS TO NORTH.

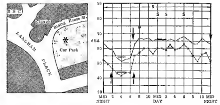


Figure 1.17

POSITION: E 1 LOCATION: PATER STREET/ABINGDON ROAD, W.8. DATE RECORDED: 31.7.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON MINOR ROAD. TRAFFIC ON RESIDENTIAL ROAD 30 YARDS EAST (KENSINGTON HIGH STREET 150 YARDS TO NORTH, SCREENED)

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC NOISE, SPEECH

AND AIRCRAFT NOISE AT HOURS SHOWN

TYPE OF DISTRICT:

RESIDENTIAL 5 STOREY FLATS,

2 STOREY HOUSES.

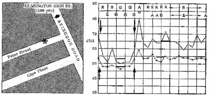


Figure 1.18

POSITION: G 27 LOCATION: EAST INDIA DOCK ROAD, E.14 DATE RECORDED: 7.5.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: IN GARDENS TO REAR OF CANTON STREET. 5 STOREY FLATS TO SOUTH SCREEN, MAIN ROAD 60 YARDS TO SOUTH

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC THROUGHOUT.

CHILDREN'S VOICES ALSO DURING

THE EVENING.

TYPE OF DISTRICT:

RESIDENTIAL. 3 STOREY TO NORTH.

5 STOREY FLATS TO SOUTH

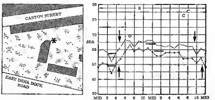


Figure 1.19

POSITION: N 7 LOCATION: SLOANE COURT/ROYAL HOSPITAL ROAD, S.W.3 DATE RECORDED: 10.10.61

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON MINOR ROAD TRAFFIC WITH BUSES SEEN AT 40 YARDS DISTANCE (ROYAL HOSPITAL ROAD)

PRINCIPAL NOISES HEARD:

PRINCIPALLY ROAD TRAFFIC NOISE.

SOME SPEECH AND AIRCRAFT AT HOURS SHOWN. GENERAL BACKGROUND AT NIGHT

TYPE OF DISTRICT:

RESIDENTIAL 5 STOREY FLATS ON BOTH SIDES

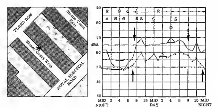


Figure 1.20

POSITION: Q 11 LOCATION: THORPARCH ROAD/WANDSWORTH ROAD, S.W.8 DATE RECORDED: 7.3.61

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: MINOR ROAD JUNCTION (ROAD WORKS ADJACENT) SCREENED FROM ARTERIAL ROAD TRAFFIC NOISE 50 YARDS DISTANT

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC AT MOST HOURS, MANY OTHER NOISES, CHILDREN, SPEECH ETC. AT HOURS SHOWN. [RAILWAY WORKS 200 YARDS NORTH]

TYPE OF DISTRICT:

RESIDENTIAL 2 STOREY HOUSES

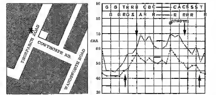


Figure 1.21

POSITION: Q 14 LOCATION: GOSLING WAY/BRIXTON ROAD, S.E.5 DATE RECORDED: 15.1.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON MINOR ROAD, TRAFFIC SEEN AT 50 YARDS. ARTERIAL ROAD TRAFFIC AT 60 YARDS SCREENED BY BLOCKS OF FLATS

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC AT MOST HOURS.

CHILDREN'S VOICES P.M. WEATHER NOISE DURING THE EVENING

TYPE OF DISTRICT:

RESIDENTIAL 5 STOREY BLOCKS OF FLATS

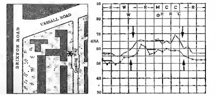


Figure 1.22

POSITION: A 16 **LOCATION** POPHAM ROAD/BISHOP STREET N.1 **DATE RECORDED:** 15.1.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE CORNER OF 2 MINOR ROADS. NO MAJOR ROAD WITHIN 250 YARDS

PRINCIPAL NOISES HEARD:

MANY LOCAL NOISES AS DETAILED

TYPE OF DISTRICT

RESIDENTIAL: ALMSHOUSES

FLATS AND TENEMENTS

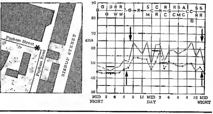


Figure 1.23

POSITION: D 2 **LOCATION:** MUNSTER SQUARE, N.W.1 **DATE RECORDED:** 13.8.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE. LOCAL TRAFFIC IN QUIET RESIDENTIAL SQUARE ADJACENT TO REGENTS PARK

PRINCIPAL NOISES HEARD:

CHILDREN'S VOICES AND DISTANT

ROAD TRAFFIC. OTHER RESIDENTIAL

NOISES AS SPECIFIED

TYPE OF DISTRICT:

RESIDENTIAL SQUARE. DETACHED

HOUSES/FLATS

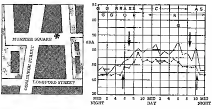


Figure 1.24

POSITION: D 23 **LOCATION** ST. ANDREWS GARDENS/GRAYS INN, W.C.1 **DATE RECORDED:** 24.4.61

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE. AT REAR OF GARDEN COURTYARD, MAIN ROAD TRAFFIC (GRAYS INN ROAD) SEEN AT 100 YARDS DISTANCE

PRINCIPAL NOISES HEARD:

DISTANT ROAD TRAFFIC AT ALL

HOURS. OTHER NOISES AS

DETAILED

TYPE OF DISTRICT:

OPEN SQUARE. HOSPITAL

AND NURSES HOME ADJACENT

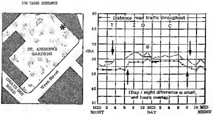


Figure 1.25

POSITION: G 1 LOCATION: WESTBOURNE GROVE, W.11 DATE RECORDED: 20.2.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: IN GARDENS TO REAR OF HOUSES FLANKING 2 MAIN RESIDENTIAL ROADS (BUS ROUTES)

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC WITH AIRCRAFT
NOISE AND SOME LOCAL
RESIDENTIAL NOISES

TYPE OF DISTRICT:

RESIDENTIAL 3 STOREY HOUSES

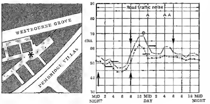


Figure 1.26

POSITION: B 5 LOCATION: ORBEL ROAD/SHUTTLEWORTH ROAD, S.W.11 DATE RECORDED: 28.3.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: BETWEEN TWO HOUSES ON MINOR ROAD. NO MAJOR ROAD WITHIN 250 YARDS

PRINCIPAL NOISES HEARD:

MANY RESIDENTIAL NOISES, LOCAL ROAD.
TRAFFIC NOISE AND TRAINS 200 YARDS AWAY
(DAYTIME LEVEL SHOWS PEAKS MORNING AND EVENING,
WHICH MAY BE DUE TO TRAFFIC AVOIDING MAIN
ROADS. AVERAGE VALUE DIFFICULT TO SPECIFY.)

TYPE OF DISTRICT:

RESIDENTIAL SEMI-DETACHED
2 STOREY HOUSES

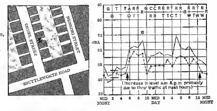


Figure 1.27

POSITION: A 6 LOCATION: PRIMROSE HILL, N.W.8 DATE RECORDED: 23.8.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: IN THE CENTRE OF AN OPEN AREA. ROADS WITH HEAVY TRAFFIC AT LEAST 300 YARDS AWAY

PRINCIPAL NOISES HEARD:

DISTANT TRAFFIC AND TRAINS AT ALL HOURS. HIGH
WINDS IN EARLY MORNING. SOME AIRCRAFT NOISE.
(NO OBVIOUS CHANGE IN NOISE LEVEL BETWEEN
DAY AND NIGHT.)

TYPE OF DISTRICT:

OPEN AREA (PARK). (NOTE SCALE OF MAP DIFFERS
FROM OTHER EXAMPLES.)

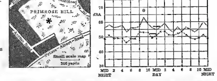


Figure 1.28

POSITION: D 1
LOCATION: SHIRLAND ROAD, W.9
DATE RECORDED: 5.6.61

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: IN GARDENS TO REAR OF MAIN RESIDENTIAL ROAD (BUS ROUTE). JOINERY WORKS AND MILK DEPOT ALSO ADJACENT

PRINCIPAL NOISES HEARD:

GENERAL RESIDENTIAL. ROAD TRAFFIC AT MOST HOURS (SCREENED BY HOUSES). SOME AIRCRAFT. NO INDUSTRIAL NOISE OBVIOUS. (DAYTIME NOISE PATTERN DOMINATED BY AIRCRAFT PEAKS. AVERAGE 10% LEVEL DIFFICULT TO ASSESS.)

TYPE OF DISTRICT:

RESIDENTIAL AND SHOPS. SOME INDUSTRY.

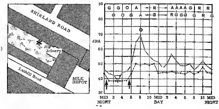


Figure 1.29

POSITION. F 25
LOCATION: MAROON STREET, E.14
DATE RECORDED: 3.5.61

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: BETWEEN BLOCKS OF FLATS OFF MINOR ROAD. RAILWAY 100 YARDS TO SOUTH EAST

PRINCIPAL NOISES HEARD:

SPEECH, SOME ROAD TRAFFIC, BIRDS AND ANIMALS

TYPE OF DISTRICT:

RESIDENTIAL 5 STOREY FLATS. COTTAGES ADJACENT

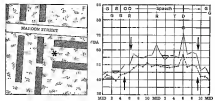


Figure 1.30

POSITION: L 2
LOCATION: ST. MARY ABBOTTS HOSPITAL, W.8,
DATE RECORDED: 29.5.61

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: RAILWAY AND COAL DEPOT WITH SIDINGS TO NORTH EAST. RESIDENTIAL ROAD 100 YARDS TO WEST (SCREENED)

PRINCIPAL NOISES HEARD:

MANY INDIVIDUAL NOISES AS SPECIFIED

TYPE OF DISTRICT:

BASICALLY RESIDENTIAL WITH RAILWAY AND DEPOT.

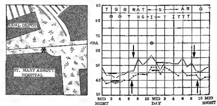


Figure 1.31

POSITION: T 18 LOCATION: CHAMPION HILL, S.E.5 DATE RECORDED: 3.1.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON ACCESS ROAD TO FLATS. LOCAL ROAD SEEN AT 30 YARDS. BUS ROUTE (SCREENED) AT 150 YARDS.

PRINCIPAL NOISES HEARD:

GENERAL RESIDENTIAL NOISES.

SOME TRAIN NOISE FROM ½ MILE NORTH

TYPE OF DISTRICT:

RESIDENTIAL 5 STOREY FLATS

AND DETACHED HOUSES

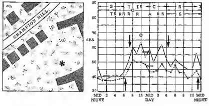


Figure 1.32

POSITION: A 11 LOCATION: KINGS CROSS LOCOMOTIVE DEPOT, N.1 DATE RECORDED: 19.11.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: MICROPHONE POSITION SCREENED FROM DIRECT VIEW OF ENGINE SHEDS AND MAIN LINE RAILWAY

PRINCIPAL NOISES HEARD:

RAILWAY NOISE AT ALL HOURS.

SPEECH, ROAD AND INDUSTRIAL NOISE

ALSO AT HOURS SHOWN

TYPE OF DISTRICT:

INDUSTRIAL (LOCOMOTIVE

DEPOT)

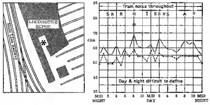


Figure 1.33

POSITION: F 3 LOCATION: WESTBOURNE TERRACE, W.2 DATE RECORDED: 21.8.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: NEXT TO MAIN RAILWAY LINE FROM PADDINGTON. WESTBOURNE ROAD BRIDGE ADJACENT

PRINCIPAL NOISES HEARD:

TRAIN NOISE THROUGHOUT. SOME

ROAD NOISE, SPEECH AND BANGING AT

HOURS SHOWN

TYPE OF DISTRICT:

MAIN LINE RAILWAY AND

GOODS DEPOT

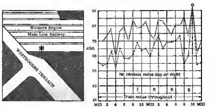


Figure 1.34

POSITION: G 24 LOCATION: CAROLINE STREET, E.1. DATE RECORDED: 15.10.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON MINOR ROAD. RAILWAY BRIDGE ADJACENT. MAIN ARTERIAL ROAD TRAFFIC SEEN AT 100 YARDS DISTANCE

PRINCIPAL NOISES HEARD:

ROAD TRAFFIC AND RAILWAY NOISE.

NO INDUSTRIAL NOISE POSITIVELY IDENTIFIED

TYPE OF DISTRICT:

INDUSTRIAL AND COMMERCIAL.

SOME TERRACED HOUSES

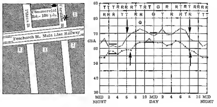


Figure 1.35

POSITION: X 2 LOCATION: KNARESBOROUGH PLACE, S.W.5 DATE RECORDED: 1.8.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON MINOR ROAD BUT OVER LONDON TRANSPORT DISTRICT RAILWAY LINE RUNNING IN CUTTING BELOW

PRINCIPAL NOISES HEARD:

FREQUENT TRAIN NOISE BY DAY. PEAK

NOISE FROM ROAD VEHICLES ADJACENT

IS HIGHER BUT LESS FREQUENT

TYPE OF DISTRICT:

RESIDENTIAL 5 STOREY TERRACED HOUSES.

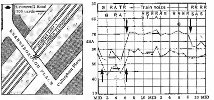


Figure 1.36

POSITION: O 12 LOCATION: BONDWAY, VAUXHALL, S.W.8 DATE RECORDED: 27.2.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON INDUSTRIAL SITE NEXT TO MAIN LINE RAILWAY AND THROUGH TRAFFIC ROUTE

PRINCIPAL NOISES HEARD:

RAILWAY NOISE AT ALMOST EVERY HOUR.

ROAD NOISE AS SHOWN. NO INDUSTRIAL

NOISE IDENTIFIED.

TYPE OF DISTRICT:

INDUSTRIAL/RAILWAY AND OLDER

RESIDENTIAL.

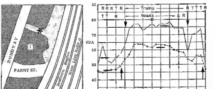


Figure 1.37

POSITION: R 8 LOCATION: ROLLO STREET, BATTERSEA, S.W.11 DATE RECORDED: 6.6.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ADJACENT TO MAIN SOUTHERN REGION RAILWAY LINE. SERVICE ROAD TO 6 STOREY FLATS ONLY

PRINCIPAL NOISES HEARD:

TRAIN NOISE AT ALMOST EVERY HOUR. CHILDREN AND ADULT VOICES ALSO AT HOURS SHOWN

TYPE OF DISTRICT:

RESIDENTIAL 6 STOREY FLATS NEXT TO RAILWAY

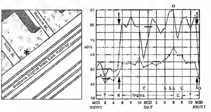


Figure 1.38

POSITION: T 10 LOCATION: GRAFTON SQUARE, S.W.4 DATE RECORDED: 5.10.61

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: QUIET SQUARE 200 YARDS FROM ANY MAJOR ROAD

PRINCIPAL NOISES HEARD:

AIRCRAFT NOISE AT 4 HOURS. LOCAL ROAD TRAFFIC. CHILDREN PLAYING. CHURCH CLOCK CHIMING.
(DAYTIME 10% LEVEL VERY VARIABLE.)

TYPE OF DISTRICT:

3 STOREY HOUSES. RESIDENTIAL

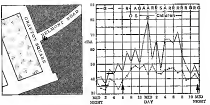


Figure 1.39

POSITION: B 14 LOCATION: WHITE CONDUIT STREET, CHAPEL MARKET, N.1 DATE RECORDED: 27.8.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON SHOPPING STREET. MARKET CLOSE BY. COMPRESSOR FOR ROADWORKS OR BUILDING OPERATIONS ADJACENT

PRINCIPAL NOISES HEARD:

COMPRESSOR NOISE AND BANGING BUT ALSO MUCH STREET NOISE FROM SHOPS AND MARKET. ONE LOUD AIRCRAFT
(THE LEVELS BY DAY ARE TOO VARIABLE FOR A MEANINGFUL AVERAGE TO BE TAKEN.)

TYPE OF DISTRICT:

COMMERCIAL AND RESIDENTIAL

3 STOREY BUILDINGS

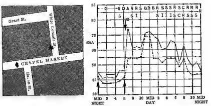


Figure 1.40

POSITION: E 16 LOCATION: FANN STREET/ALDERSGATE, E.C.1 DATE RECORDED: 3.1.61

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ADJACENT TO ROAD WORKS OR BUILDING OPERATIONS. SCREENED FROM VIEW OF MAIN ROAD NOISE

PRINCIPAL NOISES HEARD:

COMPRESSOR, DRILL, BANGING BY DAY, DISTANT ROAD TRAFFIC BY NIGHT

TYPE OF DISTRICT:

CITY, COMMERCIAL AND RECONSTRUCTION

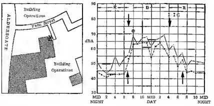


Figure 1.41

POSITION: E 18 LOCATION: PINDAR STREET, E.C.2 DATE RECORDED: 25.10.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON OPEN GROUND AMONG MINOR ROADS. BUILDING OPERATIONS OR ROAD WORKS CLOSE BY. RAILWAY 200 YARDS TO EAST.

PRINCIPAL NOISES HEARD:

BUILDING OPERATIONS AND ROAD NOISE BY DAY. HEAVY RAIN AND TRAIN NOISE AT NIGHT

TYPE OF DISTRICT:

5 STOREY OFFICES AND COMMERCIAL BUILDINGS

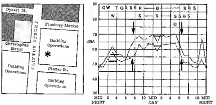


Figure 1.42

POSITION: S 10 LOCATION: WALCOTT STREET/VINCENT SQUARE, S.W.1 DATE RECORDED: 1.5.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ROADWORKS ADJACENT. TRAFFIC ON THROUGH ROUTE SEEN AT 25 YARDS

PRINCIPAL NOISES HEARD:

ROAD DRILLS AND COMPRESSOR BY DAY. ROAD TRAFFIC EVENINGS AND NIGHT. BIRDS EARLY MORNING

TYPE OF DISTRICT:

RESIDENTIAL 5 STOREY PUBLIC BUILDINGS (HOSPITAL)

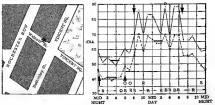


Figure 1.43

POSITION: T 14 LOCATION: CANTERBURY CRESCENT, S.W 9 DATE RECORDED: 6.4.61

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON MINOR ROAD ADJACENT TO BUILDING OPERATIONS, COMPRESSOR AND CONCRETE MIXER

PRINCIPAL NOISES HEARD:

BUILDING OPERATIONS BY DAY. ONE AIRCRAFT. LOCAL ROAD NOISE BY NIGHT. BIRDS AND TRAINS A.M.

TYPE OF DISTRICT:

RESIDENTIAL HOUSES AND FLATS.

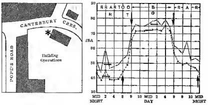


Figure 1.44

POSITION: A 20 LOCATION: BROKE ROAD/QUEENSBRIDGE ROAD, E.8 DATE RECORDED: 22.5.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON MINOR ROAD WITH SEVERAL FACTORIES ADJACENT (DISTILLERY AND CABINET WORKS)

PRINCIPAL NOISES HEARD:

FACTORY NOISE BY DAY. ROAD TRAFFIC ON MINOR ROAD. THROUGH ROUTE SEEN AT 30 YARDS. BIRDS A.M.

TYPE OF DISTRICT:

SMALL FACTORIES. 2 STOREY HOUSES

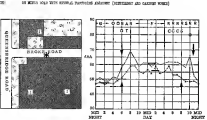


Figure 1.45

POSITION: B 16 LOCATION: BALDWIN TERRACE, N.1 DATE RECORDED: 27.9.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON MINOR ROAD NEXT TO FACTORY AREA, CANAL, AND FLATS WITH CHILDREN PLAYING

PRINCIPAL NOISES HEARD:

FACTORY NOISE (WITH PRESSES) BY DAY. CHILDREN, ROADS AND GENERAL BACKGROUND NOISE AT NIGHT.

TYPE OF DISTRICT:

INDUSTRIAL AND RESIDENTIAL FLATS AND HOUSES.

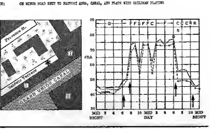


Figure 1.46

POSITION: C 13 LOCATION: UNION CRESCENT/LONG STREET, E.C.2. DATE RECORDED: 15.11.62

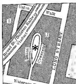
LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: AMONG FACTORIES. RAILWAY VIADUCT ADJACENT.

PRINCIPAL NOISES HEARD:

FACTORY NOISE AT MOST HOURS OF DAY. TRAINS AT ALMOST EVERY HOUR. SOME LOCAL ROAD NOISE

TYPE OF DISTRICT:

INDUSTRIAL AREA. 4 STOREY BUILDINGS



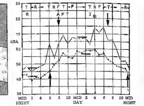


Figure 1.47

POSITION: E 13 LOCATION: JOHN'S MEWS, W.C.1 DATE RECORDED: 30.7.62

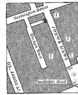
LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: IN CUL-DE-SAC OFF MINOR ROAD. COUNCIL DEPOT AND INDUSTRIAL PREMISES CLOSE BY

PRINCIPAL NOISES HEARD:

ROAD AND FACTORY NOISE BY DAY (MUSIC FROM MUSICAL INSTRUMENT FACTORY)

TYPE OF DISTRICT:

INDUSTRIAL AND COMMERCIAL 2 AND 3 STOREY BUILDINGS



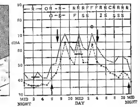


Figure 1.48

POSITION: F 4 LOCATION: PADDINGTON WHARF, W.2. DATE RECORDED: 20.8.62

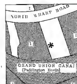
LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: AMONG INDUSTRIAL BUILDINGS ENGINEERING WORKS AND WHARVES

PRINCIPAL NOISES HEARD:

INDUSTRIAL BY DAY. GENERAL BACKGROUND OF MACHINERY WITH SOME ROAD TRAFFIC AT NIGHT

TYPE OF DISTRICT:

INDUSTRIAL AND CANAL WHARVES



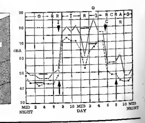


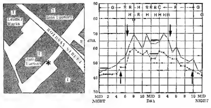
Figure 1.49

POSITION: E 18 LOCATION: ROTHSAY STREET, S.E.1 DATE RECORDED: 21.2.61

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: IN YARD OF JAM FACTORY. OTHER INDUSTRIAL PREMISES ADJACENT. LOCAL ROAD TRAFFIC

PRINCIPAL NOISES HEARD:

BANGING AND LOCAL ROAD TRAFFIC



TYPE OF DISTRICT:

INDUSTRY WITH SOME FLATS (R)

OPPOSITE

Figure 1.50

POSITION: E 21 LOCATION: LONDON DOCKS DATE RECORDED: 19.1.61

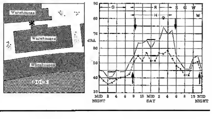
LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: AMONG WAREHOUSES SCREENED FROM DIRECT VIEW OF DOCK OR RIVER

PRINCIPAL NOISES HEARD:

LOCAL ROAD TRAFFIC, BANGING BY

DAY. RAIN, WIND AND GENERAL

NOISE AT NIGHT



TYPE OF DISTRICT:

INDUSTRIAL, DOCKS AND

WAREHOUSES

Figure 1.51

POSITION: E 4 LOCATION: LOMBARD WHARF, S.W.11. DATE RECORDED: 27.7.62

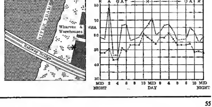
LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON A THAMES-SIDE WHARF ADJACENT TO A RAILWAY BRIDGE

PRINCIPAL NOISES HEARD:

MACHINERY, BANGING NOISE BY DAY.

ROAD TRAFFIC, AIRCRAFT AND TRAINS

DURING EVENING AND NIGHT



TYPE OF DISTRICT:

INDUSTRIAL AND COMMERCIAL

Figure 1.52

POSITION: A 18 LOCATION: DE BEAUVOIR CRESENT/GRAND UNION CANAL, N.1 DATE RECORDED: 13.11.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: AT THE SIDE OF THE CANAL NEXT TO FACTORY (I) AND RESIDENTIAL FLATS (R)

PRINCIPAL NOISES HEARD:

ENGINE RUNNING. SOME BUILDING OPERATIONS. CHILDREN PLAYING. DISTANT ROAD AND TRAIN NOISE AT NIGHT

TYPE OF DISTRICT:

RESIDENTIAL, INDUSTRIAL AND CANAL

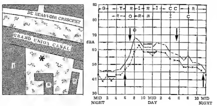


Figure 1.53

POSITION: E 13 LOCATION: WATERLOO POLICE PIER, W.C.2 DATE RECORDED: 17.12.62

LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: ON PIER AT RIVER EDGE. ROAD TRAFFIC ON EMBANKMENT AND WATERLOO BRIDGE ABOVE (SCREENED)

PRINCIPAL NOISES HEARD:

RIVER TRAFFIC AT MOST HOURS. SOME TRAINS AND ROAD TRAFFIC HEARD

TYPE OF DISTRICT:

RIVERSIDE, PUBLIC BUILDINGS, GARDENS.

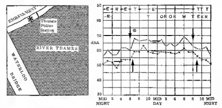


Figure 1.54

POSITION: E 18 LOCATION. BILLINGSGATE MARKET DATE RECORDED: 10.1.61

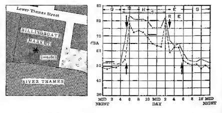
LOCATION RELATIVE TO PRINCIPAL NOISE SOURCE: INSIDE COVERED MARKET

PRINCIPAL NOISES HEARD:

MUCH BANGING AND SHOUTING DURING TRADING HOURS. OCCASIONAL LOCAL NOISES OTHERWISE

TYPE OF DISTRICT:

COVERED MARKET IN COMMERCIAL AREA



Appendix 2

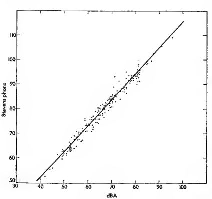
On the accuracy of simple weighting networks for loudness estimates of some urban noises

Reprinted from *Journal of Sound and Vibration*, 1965, vol. 2(1), pp 86–8, 'Letter to the Editor'.

In 1960 a large-scale survey of noise in London was being planned. The noise levels at many places were to be recorded, and it was necessary to decide on some automatic method of analysis of the recordings, preferably in terms of loudness. We decided to use an apparatus similar to that used by Van den Eijk[1] which measured the periods for which the noise level exceeded certain specified levels. The use of this apparatus precluded any of the then current methods of loudness calculation[2,3,4] because they all relied on frequency analyses. Thus we wanted to find some frequency weighting network which would give a reasonably accurate measure of loudness.

At that time there had been several suggestions that loudnesses could be obtained from simple weighting networks (e.g. by R.W. Young[5]), and since then it has become quite common to use such networks, in particular the 'A' weighting. However, we still get requests for details of our 1960 calculations of loudness versus weighting, and so it was thought that it would be worth publishing this brief account.

Figure 2.1
Stevens phons *v.* dBA.



We were interested in the types and ranges of noises which were likely to be found in London, i.e. urban noises. Thus we investigated road traffic noise (from heavy lorries to two-stroke motorcycles and from the kerb-side to back gardens; 71 measurements); rail traffic noise (main line and goods yard at 50 to 200 ft; 49 measurements); aircraft noise (cruising in more-or-less level flight at 1000 ft and upwards; 41 noises); and civil engineering plant noise (e g concrete mixers, pneumatic drills, at 20 ft; 24 measurements). All these 185 noises were analysed in terms of Stevens phone[2], Zwicker phons[3], and PNdB[4], and were plotted in turn against the calculated A, B, and N weighted sound levels. Regression lines were calculated for each plot and the best fitting straight lines, given in the form y (phons or PNdB) $= m\,x$. (A,B or N weighted dB) $+ c$ are listed in Table 1 together with the ranges and the standard deviatious of the points about the lines. (The A and B networks used were the international standard ones and the N network was as in reference.[4])

A plot of Stevens phons against dBA is shown in Figure 2.1

Thirty of the noises were used to check the relationships between the three loudness calculation methods and the unweighted sound pressure levels. The scatter was high in each case, the standard deviation about the best straight line being about ± 3,5 to 4 units. Also, a smaller sample of the noises was used to check the calculated loudnesses from the three methods against dBA for noises up to 55 dB, dBB for noises between 55 and 85 dB and flat for higher levels, that is how it was originally intended that the weighting curves should be used. Again, the scatter of the points about the best straight line was large.

It will be seen that, of the different weighting curves, the A curve gives Zwicker phons most accurately, with a standard deviation of ± 1,7 phons. Stevens phons are given with slightly greater accuracy by using B weighting and the standard deviation of the points about the best fitting straight line is 1,4 phons. Most accurate, with a standard deviation of only ± 1,2 PNdB, is the prediction of PNdB from the N weighted sound levels.

Any of the above relationships—dBA to Zwicker phons, dBB to Stevens phons and dBN to PNdB—are quite accurate enough for most practical purposes. The standard deviations ranging from ± 1,7 to ± 1,2 phons are not very much greater than those resulting from the comparison between the calculated and subjective loudnesses of the 'standard' noises.[6,7,8]

Since this work was done the methods of calculating Stevens phons and pHdB have been modified slightly[9],[10], and this will obviously alter our relationships shown in Table 2.1. The spectra of the 185 noises are available from us[11] if anyone wants to recalculate the phons.

P. H. Parkin

Department of Scientific and Industrial Research,
Building Research Station,
Garston, Watford, Herts,
England

Received 10 *September* 1964.

Table 2.1

y	*x*	*m*	*c*	Standard deviation	Range
Stevens phons	dBA	1,05	10,1	±2,0 phons	+8,5 phons −4,5
Zwicker phons	dBA	0,99	20,5	±1,7 phons	+5,5 phons −4,5
PNdB	dBA	1,04	1,30	±2,4 PNdB	+6 PNdB −6
Stevens phons	dBB	1,09	2,8	±1,4 phons	+5,5 phons −3,5
Zwicker phons	dBB	1,01	14,3	±1,9 phons	+4 phons −7
PNdB	dBB	1,06	7,0	±2,9 PNdB	+9 phons −6,5
Stevens phons	dBN	1,01	4,8	±1,7 phons	+3,5 phons −5,5
Zwicker phons	dBN	0,94	15,8	±1,7 phons	+3 phons −7
PNdB	dBN	1,02	6,7	±1,2 PNdB	+2PNdB −5

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11. 1961 Building Research Station Note B.237.

Appendix 3

Summary from The Government Social Survey 'Noise Annoyance in Central London'.

This survey[4] by A. C. McKennell and E. A. Hunt was made by the Central Office of Information for the Building Research Station in 1961.

Interviews were carried out in the summer of 1961 using a standardised schedule with a representative sample of 1377 adults residing within an area of about 35 to 40 square miles in Central London around Charing Cross. The object of the survey was to set noise in perspective with other factors, and to ascertain the relative effects on daily living of indoor and outdoor noise.

Noise effects in relation to other inconveniencies of living in Central London

Noises of different kinds are mentioned spontaneously by over one-fifth of the sample as a thing which they dislike about the area in which they live. Lack of cleanliness or shoddy living conditions in one form or another (slums, dirt, smoke etc.) is mentioned by over three-tenths, and the type of people in the area by over one-quarter.

Over one-tenth name noise of some kind as the one thing they would most like to change in their area. This proportion is exceeded by those mentioning public facilities of one kind or another, and equalled by the proportions naming either lack of cleanliness, or type of people or amount of traffic. Only six per cent name noise of any kind as a reason for wishing to move away from their area, while many more than this name other factors. Therefore, taking these unprompted replies as a whole, it seems that there is a substantial number of people to whom noise is most salient among the inconveniences they find in living in Central London, but there is a greater number to whom other kinds of inconvenience are more important.

The direct effects of noise

Among the direct effects of noise is that it interferes with activities of various kinds. The replies to questions which specifically mentioned noise indicate that there are about one third of the inhabitants of Central London who do not regard noise as a serious problem, and rather less than this who do suffer some serious annoyance fairly often. Annoyance with sounds appears to be more closely connected with the nature of the effect produced than with the frequency with which the effect occurs. Thus interference with sleep or rest appears more likely to cause annoyance than interference with activities such as conversation or watching TV. About one quarter of the sample said that noise sometimes interfered with their sleep, while just over forty per cent claimed to have someone in their household whose sleep is disturbed by noise. Disturbances to sleep are more than twice as likely to arise from outdoor noises than from noises from neighbours.

The total noise environment

In terms of both awareness and annoyance, sounds heard when at home are of greater importance in the noise environment than are sounds heard outdoors or at work. The difference is particularly marked in the case of annoyance more than twice as many people are bothered by sounds when at home as are bothered by sounds outdoors. Road traffic is unquestionably the most important individual sound heard by, and bothering, people when at home and when outdoors. At work, it takes second place to industrial or constructional sounds.

Sounds heard in the home

Sounds originating out of doors are much more important than sounds originating in neighbours' dwellings or in people's own homes. This is true both in terms of sounds heard and sounds which bother. Road traffic is the most frequently mentioned sound which is heard and which bothers. Nevertheless road traffic is not intrinsically the most bothersome sound. This is shown by the fact that the percentage of those who hear road traffic in their homes who are bothered by it is less than for some other sounds. No straightforward relationship was found between type of dwelling and the extent of sound annoyance from sounds originating outdoors. There is, however, a marked difference in awareness of and annoyance with sounds originating in neighbours' dwellings. Flat dwellers suffer most and dwellers in detached houses suffer least in this respect.

Noise in relation to social class

On the basis of such physical measurements of noise levels as were available, there appears to be no marked difference in the objective noise environments of different social classes within Central London. There are some significant differences in the effects of noise on people in different social classes, however. At the top end of the social scale people are more likely to be bothered by the noises they hear than are people at the lower end. They are also bothered by more individual noises on the average. The differences between manual and non-manual classes are also marked.

Noise in relation to personal susceptibility

A scale was derived to measure different degrees of susceptibility or attitude to noise. Susceptibility as measured on this scale was found to be completely unrelated to the available physical measurements of the noise environment of the informant Awareness of sounds showed only a small increase with increased susceptibility measured on this scale However the extent of annoyance both to sounds in general, and to particular sounds, as described in earlier chapters, was very strongly related to scores on the susceptibility scale. Age and social class accounted for only a minor portion of the variability in noise susceptibility. It is thought that the major portion of the variation in noise susceptibility may be related to as yet uninvestigated personality factors and the effect of differences in experience over time. Annoyance with sounds heard at work, although still related to scores on the noise susceptibility scale, does not show such a marked increase with susceptibility as is the case for sounds heard at home and outdoors. This suggests that selective factors are operating according to which people of high noise susceptibility have been able to avoid entering noisy occupations—to an extent far greater than they have been able to avoid living in noisy home environments.

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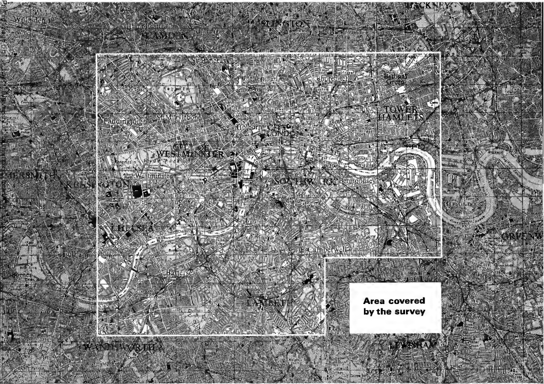
Area covered by the survey
HACKNEY
CAMDEN
WESTMINSTER
KENSINGTON
CHELSEA
SOUTHWARK
TOWER HAMLETS
LAMBETH
WANDSWORTH
LEWISHAM
Paddington
Holborn
Bermondsey
Camberwell
Battersea
Fulham

Building Research Station
Ministry of Public Building and Works

London Noise Survey

P. H. Parkin B Sc
H. J. Purkis B Sc B A
Building Research Station

R. J. Stephenson M Sc Ph D F R I C A M Inst W P C
Greater London Council

B. Schlaffenberg Dr Arch (Rome) Dip T P M T P I
London Borough of Camden (formerly of London County Council)

London: Her Majesty's Stationery Office 1968

Figure 1 (frontispiece, page ii)
Area covered by the survey

Preface

Noise is one of the factors in many urban planning problems, and although it is obvious that noise has become a major form of 'pollution' in cities and towns, very few facts about it are available. The survey with which this report deals was made at the request of the London County Council (now GLC). The Building Research Station had the technical facilities for the measurements, and the Council was uniquely placed to undertake the planning and organisation. The resulting pleasant collaboration produced this survey, which can form a basis for further more detailed work on noise in cities and towns, and which also provides a record of noise levels in London, for comparison with other cities and future trends.

At the same time as the objective survey reported here, the Government Social Survey, at the request of the Building Research Station made a survey of the subjective reactions to noise of people living in Central London. This has been reported separately, but a summary appears here in an appendix.

J. C. Weston
Director

Building Research Station
Garston, Watford
Herts

January 1968

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